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In This Issue

Quality Control Methods For Two Related Variables

Corrective Action in a Quality Control Program

Some Uses of Statistics in Plant Maintenance

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1946—TENTH ANNIVERSARY YEAR—1956

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Statistical Quality Control has come a long way over the years. The technical programme this year, culminating ten years of development, will bring to you a cross section of techniques and applications designed to interest everyone. In addition, you will be afforded the opportunity of seeing S.Q.C. programmes in operation at several industrial plants.

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The Social Evening, to be held in the Champlain Room of the Mount Royal Hotel on June 6th, will offer you drawing room comfort for exchanging greetings with your friends. The Ball Room of the Mount Royal will provide the setting for the 10th Anniversary Banquet, which you must not miss.

Watch for details of your 1956 Convention programme in following issues of Industrial Quality Control. Above all, won't you give us the opportunity of welcoming you personnally at the Convention in Montreal on June 6, 7 and 8, 1956?

Yours sincerely,

Ben Lloyd

Ben Lloyd, Chairman
Tenth Convention Committee.

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Quality Control Methods

J. EDWARD JACKSON

Introduction

Of increasing importance in the field of statistical quality control is the simultaneous control of two or more related variables when the quality depends on the joint effect of these variables rather than on the effect of each variable separately. W. A. Shewhart[1] referred to this situation as far back as 1931 and H. Hotelling has written several articles which specifically handle these problems in detail.[2,3,4,5] It is the purpose of this article to outline the need for simultaneous control of related variables and to illustrate by a numerical example

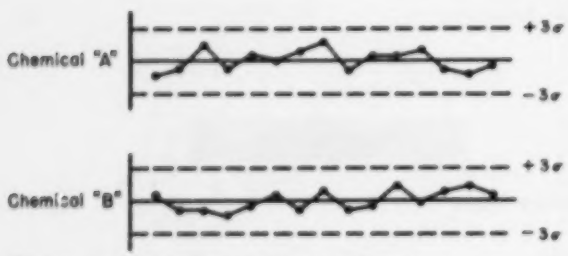

Figure 1—3σ Control Charts for Chemicals A and B

the computational methods used in the case of two variables. All of the material in this article is for the case where individual observations rather than averages and ranges are being controlled. This situation arises in industry when more frequent sampling is too expensive or time-consuming, and action must be taken after each observation is made rather than after, say, a sample of five is obtained. What is presented here can be extended to subgrouping, so that certain other properties of the bivariate normal distribution, such as the joint mean or a measure of dispersion, can be controlled. This, however, will have to be considered in a future article.

Many times related variables will appear to be in statistical control when the system is actually out of control. The reason for this can be shown in the following hypothetical, two-dimensional examples where the two variables are distributed according to the bivariate normal distribution.

Two chemicals in a certain solution, both having the same variance, are ordinarily controlled by the usual 3σ (or 99.7 percent) control chart technique as shown in Fig. 1. Treating these two variables independently, the effect is the two-dimensional case as shown in Fig. 2 so that the process is considered to be in control only when it plots in the shaded area, this being the case where both variables are within their own control limits. The probability of both chemicals, when in control, having extreme values either high or low at the same time is very slight however and, in fact, is less than 0.3 percent which is the probability that either one will plot on its control limit when controlled separately. The probability that either variable, when in control will plot at one or the other control limit is 0.3 percent, but the joint probability that both of them are there at the same time (i.e., the corners of the box in Fig. 2) is the product of these probabilities: 0.3 percent × 0.3 percent = 0.0009 percent or much less than 0.3 percent. On the other hand, the probability that both variables will be in control at the same time is 99.7 percent × 99.7 percent = 99.4 percent.

It develops then, that the joint region of control, with probability 99.7 percent, is not the shaded square in Fig. 2, but a circle such as the one in Fig. 3a. If the two independent sets of control limits were in use, a point plotting in Region 1 would correctly indicate the system to be in control. A point plotting in Region 2 would correctly indicate the system to be out of control. How-

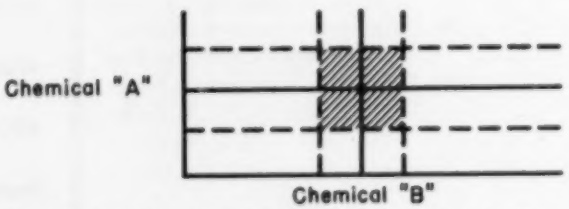

Figure 2—Two Dimensional Control Using Independent 3σ Limits

ever, a point plotting in Region 3 would indicate the process to be in control when actually it is out of control and hence Region 3 is an area of under-control. Conversely, a point plotting in Region 4 would lead one to assume the process to be out of control when actually it is in control and hence Region 4 is an area of over-control. These errors are more pronounced if 2σ limits are used, as the probability of both variables being in control is 95.4 percent × 95.4 percent = 91.0 percent. If the variances of the two chemicals are not equal, which is generally the case, this control region will assume the shape of an ellipse such as the one shown in Fig. 3b.

The problem becomes more complicated when the variables are correlated, which is often the case. If the variables are correlated, the ellipse is tipped so that the major axis coincides with the orthogonal regression line

For Two Related Variables

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between the variables. (This regression line is the line of best agreement between the variables in the sense that it minimizes the sum of squares of deviations perpendicular to the line itself.) Moreover, the higher the degree of correlation, the narrower the ellipse becomes until, in the limiting case of perfect correlation, it degenerates to a straight line. In the following case, the two chemicals have a high negative correlation (i.e., as chemical E increases, chemical F decreases). Their control ellipse is superimposed on the original sets of independent control limits shown in Fig. 3c. In this example, the errors of controlling related variables separately are made more apparent. The larger the correlation coefficient, the narrower the ellipse will become and, in particular, the larger the error of assuming the process to be in control when actually it is not. As more variables are controlled, these errors become more pronounced.

Hotelling[4,5] has treated this topic in great detail by use of T^2 control charts in which one overall measure is obtained for each pair of sample values. The advantage of this method is that the status of the process can be characterized in one number. Its only disadvantage lies in the fact that if an out of control condition does exist, one must go back to the original data to determine the nature of this condition. The use of control ellipses overcomes this difficulty and also some of the computational difficulties as will be seen later; however, the time scale is lost (unless the points are numbered in order of time.)

Example

The numerical example accompanying this article illustrates a situation which occurred in a film developing solution. Several routine chemical analyses were made periodically on this solution and the results were plotted in the form of regular control charts. Hydroquinone and Elon were two of the materials analyzed. These were suspected of being correlated as there seemed to be a tendency for them to rise and fall together. A suitable base period of 75 successive analyses, during which time no trouble had occurred, was selected for the purpose of determining the variability of the analyses, the relationship between them, and the possible errors incurred by ignoring this relationship. The individual observations are shown in Fig. 4 together with their 95 percent limits. Individual observations are a much less powerful control tool than averages, and the usual wide 3σ limits in such cases

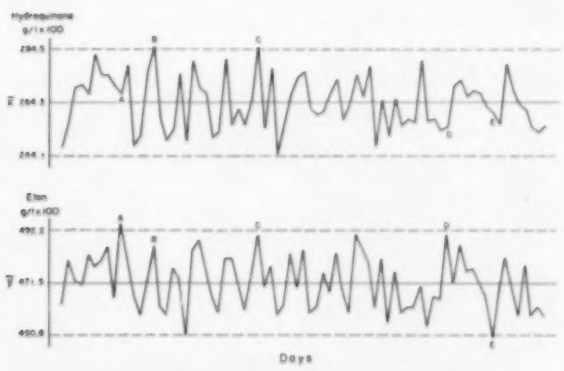

Figure 4—95% Limits For Hydroquinone and Elon

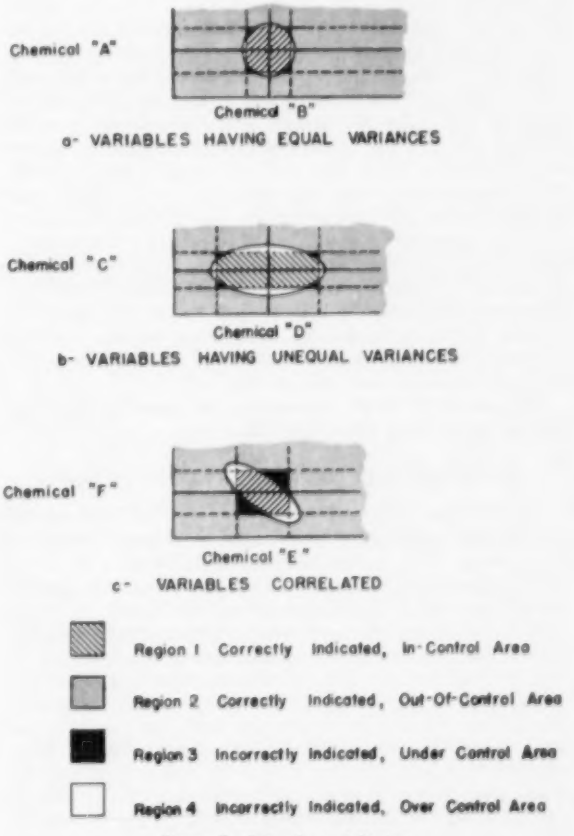

Figure 3—Joint Control Regions

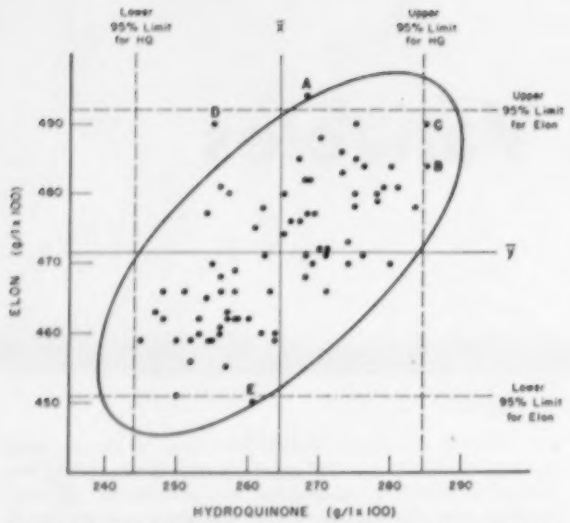

Figure 5—95% Control Ellipse for Joint Control of Elon and Hydroquinone

may be rather too insensitive, practically, for detecting out of control conditions. One way of compensating for this is to use 95 percent limits, thus perhaps obtaining a more equitable and practical balance between the Type I error(α) and the Type II error(β): that is, α, the probability of looking for non-existent trouble is increased from 0.003 to 0.05, while β, the probability of failing to detect trouble when actually the process level is at the 3σ limit is reduced from 0.05 to about 0.16. For a similar reason, 95 percent limits were used in computing the control ellipse which is shown in Fig. 5 together with the individual 95 percent limits for each chemical if each were controlled separately. This shows that as the data are quite well correlated ($r=0.65$, $N=75$,) the correct bivariate control region is somewhat different from that for individual control limits. It is interesting to note that point "D" would have been judged in control if plotted on the ordinary separate control charts but is actually out of control. Conversely, points "B", "C", and "E" which would have been classified as out of control, are actually in control. Point "A" is out of control by both methods. Points "A" and "D" should be investigated for assignable causes. In this particular example, none were found, so the data points were not deleted from the sample.

The computational procedure for constructing this ellipse is given in the Appendix.

Comparison with Hotelling's T^2 Control Charts

The results obtained from this type of control are exactly the same as if Hotelling's T^2 control chart had been used. The mathematical relationships are shown in the Appendix. Figure 6 shows the same data plotted in the form of a Hotelling's T^2 control chart. As these charts represent the generalized distance of each observation from the standard, the higher the value of T^2, the further the process is from standard, so T^2 charts need only an upper limit. If an observation is outside the ellipse, it will be above the limit on the T^2 chart and hence indicate an out of control condition. If an observation is inside the ellipse, it will plot below the limit line of the T^2 chart. If an observation is exactly on the perimeter of the ellipse, it will be exactly on the limit line of the T^2 control chart.

Conclusion

Individual or separate control of related variables will result in errors of "over" and "under" control. These errors become more pronounced if the variables are correlated. Control of individual observations, assuming that they come from a bivariate normal distribution, may be done by means of a control ellipse or by means of Hotelling's T^2 control chart. The results obtained by each method are identical. The T^2 control chart retains the time scale and summarizes the condition of the process by one number while the use of the control ellipse will indicate pictorially the nature of the out-of-control conditions.

Appendix

Illustration of Computational Procedure

Let the variables under consideration be x = hydroquinone in grams/liter $\times$ 100, and y = Elon in grams/liter $\times$ 100. To construct the ellipse, five quantities must be computed: $\bar{x}$, $\bar{y}$, s^2_x, s^2_y, and s_{xy}, the latter being the sample covariance between x and y. In the general problem, if the lengths of the major and minor axes of the ellipse and the slope of either one are known, the ellipse can be drawn by geometric methods since its center is the intersection of the two means $\bar{x}$ and $\bar{y}$. This was the method proposed by Shewhart. This article will extend that method to the point where

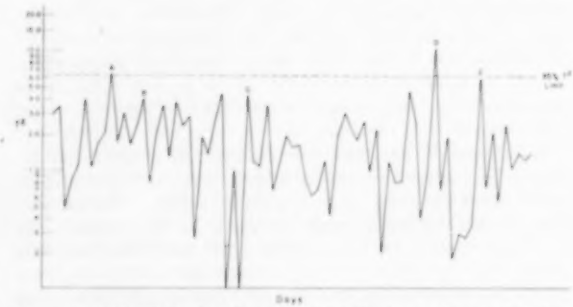

Figure 6—95% T^2 Control Chart for Joint Control of Elon and Hydroquinone

the ellipse may be plotted in the original x and y coordinates and will also make the necessary corrections for small sample size.

In the example ($N=75$,) the sample means are:

$$\bar{x} = 264.32$$

$$\bar{y} = 471.48$$

The sample variances and the covariance are:

$$s^2_x = \frac{N\Sigma x^2 - (\Sigma x)^2}{N(N-1)} = \frac{(75)(5247476) - (19824)^2}{(75)(74)} = 102.65$$

$$s^2_y = \frac{N\Sigma y^2 - (\Sigma y)^2}{N(N-1)} = \frac{(75)(16679993) - (35361)^2}{(75)(74)} = 107.96$$

$$s_{xy} = \frac{N\Sigma xy - \Sigma x \Sigma y}{N(N-1)} = \frac{(75)(9351716) - (19824)(35361)}{(75)(74)} = 68.87$$

The sample correlation coefficient is $r = \frac{s_{xy}}{s_x s_y} = 0.65$, so it can be seen that fairly high correlation exists between the variables and that the errors, particularly of "under-control," should be corrected.

The only other quantity which must be known in advance is some constant associated with the probability level to be employed. If the means and variances were known, this constant would be obtained from the χ^2 table with two degrees of freedom. However, since these quantities are estimated from the sample, an approximation to χ^2 must be made analogous to the use of the t-distribution for the univariate case. This approximation is aptly called T^2 and may be determined by the relationship: $T^2 = \frac{2(N-1)F\alpha}{N-2}$ where $F\alpha$ is obtained from the F tables with a significance level of α and $n_1 = 2$ and $n_2 = N-2$ degrees of freedom. In this example, the ellipse is to be constructed which will include 95 percent of the population, assuming the observations are from a bivariate normal distribution; therefore, in this case, $\alpha = 0.05$. Since $N = 75$, $F_{0.05}$ (with $n_1 = 2$ and $n_2 = 73$ degrees of freedom) $= 3.12$ and $T^2 = \frac{2(74)(3.12)}{73} = 6.325$.

The equation for this ellipse in terms of x and y coordinates is:

$$\frac{s^2_x s^2_y}{s^2_x s^2_y - s^2_{xy}} \left[\frac{(x-\bar{x})^2}{s^2_x} + \frac{(y-\bar{y})^2}{s^2_y} - \frac{2s_{xy}(x-\bar{x})(y-\bar{y})}{s^2_x s^2_y} \right] = T^2$$

Substituting the values for this example:

$$1.748 \left[\frac{(x-264.32)^2}{102.65} + \frac{(y-471.48)^2}{107.96} - \frac{(x-264.32)(y-471.48)}{80.45} \right] = 6.325$$

This would be tedious to employ, so the following method is used.

Two quantities λ_1 and λ_2 are computed. (These are sometimes called characteristic roots, latent roots, or eigenvalues.) They are the roots of the quadratic equation: $\lambda^2 - (s^2_x + s^2_y)\lambda + [s^2_x s^2_y - (s_{xy})^2] = 0$, which can be found using the familiar quadratic formula:

$$\lambda = \frac{(s^2_x + s^2_y) \pm \sqrt{(s^2_x + s^2_y)^2 - 4[s^2_x s^2_y - (s_{xy})^2]}}{2}$$

In this problem, $\lambda_1 = 174.22616$ and $\lambda_2 = 36.38384$. The physical interpretation of these values is that the length of the semi-major axis is $\sqrt{\lambda_1 T^2}$ and of the semi-minor axis is $\sqrt{\lambda_2 T^2}$.

At this stage it would be well to introduce two computational checks:

(1) $\lambda_1 + \lambda_2 = s^2_x + s^2_y$
(2) $\lambda_1 \lambda_2 = s^2_x s^2_y - (s_{xy})^2$

In this example, $\lambda_1 + \lambda_2 = 210.61$ which checks exactly and $\lambda_1 \lambda_2 = 6339.0167$ which differs from $s^2_x s^2_y - (s_{xy})^2$ by 0.0004.

The remaining requirement for uniquely determining this ellipse is the slope of the major axis. This line is the orthogonal regression line which differs from the regression of y on x in that it minimizes the sum of squares of the deviations of the observations perpendicular to the line itself. The slope of this line is $b = \frac{\lambda_1 - s^2_x}{s_{xy}}$. In this example, the slope $b = \frac{174.22616 - 102.65}{68.87} = 1.039294$. Once the lengths of the major and minor axes and the slope of either one are given, the ellipse can be drawn as proposed by Shewhart (see Fig. 7.) If, however, the x and y coordinates are desired, the following method may be used: The following values are calculated:

$$v_{1x} = \sqrt{\frac{\lambda_1}{b^2+1}} = \sqrt{\frac{174.22616}{2.080132}} = 9.151899$$

$$v_{1y} = bv_{1x} = (1.039294)(9.151899) = 9.511514$$

$$v_{2y} = \sqrt{\frac{\lambda_2}{b^2+1}} = \sqrt{\frac{36.38384}{2.080132}} = 4.182239$$

$$v_{2x} = -bv_{2y} = -(1.039294)(4.182239) = -4.346576$$

The ratios $\frac{v_{1y}}{v_{1x}}$ and $\frac{v_{2y}}{v_{2x}}$ are still the slopes of the major and minor axes but in this form, they may be multiplied by functions of T^2 to determine points on the ellipse.

More computational checks may be added at this point:

$$\begin{aligned} v^2_{1x} + v^2_{1y} &= \lambda_1 \\ v^2_{2x} + v^2_{2y} &= \lambda_2 \\ v_{1x}v_{2x} + v_{1y}v_{2y} &= 0 \\ v_{1x}{}^2 + v_{2x}{}^2 &= s_x{}^2 \\ v_{1y}{}^2 + v_{2y}{}^2 &= s_y{}^2 \\ v_{1x}v_{1y} + v_{2x}v_{2y} &= s_{xy} \end{aligned}$$

In this example:

$v^2_{1x} + v^2_{1y}$ = 174.22615 which differs from λ_1 by 0.00001
$v^2_{2x} + v^2_{2y}$ = 36.38385 which differs from λ_2 by 0.00001
$v_{1x}v_{2x} + v_{1y}v_{2y}$ = 0.00000
$v_{1x}{}^2 + v_{2x}{}^2$ = 102.65 = $s_x{}^2$
$v_{1y}{}^2 + v_{2y}{}^2$ = 107.96 = $s_y{}^2$
$v_{1x}v_{1y} + v_{2x}v_{2y}$ = 68.87 = s_{xy}

To actually compute coordinates for points on the perimeter of the ellipse, the value T^2 must be broken into sets of real numbers, g and h, such that $g^2 + h^2 = T^2$. It is common to use 0, 1, 2, etc., as the values for either g or h, so that the corresponding values for the other

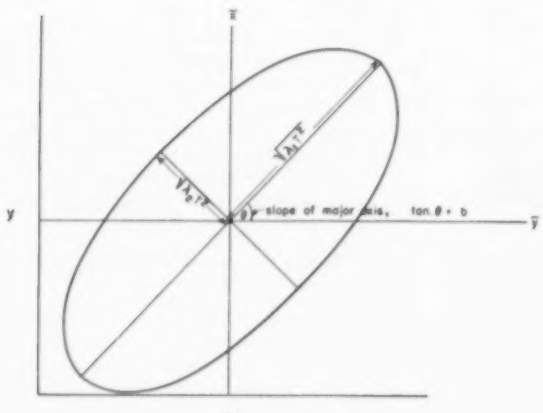

Figure 7—Properties of a Control Ellipse

would be T, $\sqrt{T^2-1}$, $\sqrt{T^2-4}$, etc. The coordinates of one point on the perimeter will be $x + gv_{1x} + hv_{2x}$ and $y + gv_{1y} + hv_{2y}$. For example, if h = 0, g = T = 2.515.

$$\begin{aligned} x + \; & gv_{1x} + hv_{2x} \\ & = 264.32 + (2.515)(9.152) + (0)(-4.347) \\ & = 287.34. \\ y + \; & gv_{1y} + hv_{2y} \\ & = 471.48 + (2.515)(9.512) + (0)(4.182) \\ & = 495.40. \end{aligned}$$

So x = 287.34 and y = 495.40 are the coordinates for one point on the ellipse. In general, three more points may be obtained by using −g and h, g and−h, and −g and −h except in the case where either g or h is zero. Four more points may be obtained by interchanging the values of g and h. In all of these cases, the relationship $g^2 + h^2 = T^2$ holds.

For example, using 1 and $\sqrt{T_2-1} = 2.308$ in these various combinations, the following eight points may be found:

g	h	x	y
2.308	1.000	281.10	497.62
−2.308	1.000	238.85	453.71
2.308	−1.000	289.79	489.25
−2.308	−1.000	247.54	445.34
1.000	2.308	263.44	490.64
1.000	−2.308	283.50	471.34
−1.000	2.308	245.14	471.62
−1.000	−2.308	265.20	452.32

Many times in practice, only a few of these need be found numerically as the rest may be determined graphically using the properties of symmetry about the origin and about the axes of the ellipse. The use of g or h values of 0, 1 and 2 are usually sufficient to construct an ellipse. Occasionally a value of 3 is used but in this case it would be impossible since $\sqrt{T^2-9}$ would be imaginary. In this case, were more points necessary, 0.5 or 1.5 might be used. Alternatively, the ellipse may be plotted using techniques of Analytical Geometry.

Comparison with Hotelling's T^2 Control Charts

As has been shown in Fig. 6, the results obtained from this type of control are exactly the same as if Hotelling's T^2 control chart had been used. T^2 is computed by means of the formula:

$$T^2 = \frac{s^2_x s^2_y}{s^2_x s^2_y - s^2_{xy}} \left[\frac{(x-\bar{x})^2}{s^2_x} + \frac{(y-\bar{y})^2}{s^2_y} - \frac{2s_{xy}(x-\bar{x})(y-\bar{y})}{s^2_x s^2_y} \right]$$

This is the same formula as that used for the equation of the ellipse, except that when the equation was used to find the ordinates of the ellipse itself, T^2 was a constant and the equation was solved for x and y. In the present case, however, the actual sample values of x and y are substituted in the equation to determine the corresponding values for T^2. If the value of T^2 is less than 6.325, it will be in control on the T^2 control chart and inside the ellipse of Fig. 5. If the value is greater than 6.325, it will be out of control on the T^2 control chart and outside the control ellipse. If the value of T^2 is exactly 6.325, it will be exactly on the control limit of the T^2 control chart and will plot exactly on the perimeter of the ellipse.

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Corrective Action in a Quality Control Program

HENRY I. MATOSOFF

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A well organized and workable program of corrective action should be initiated to "control" the quality of product in a manufacturing enterprise. There are three fundamental stages for "control," and "control" exists in name only if any one is lacking. The stages of control are:

- *Determine goals or set standards which are desired*

  The quality control programs of the military and many leading industrial organizations have undertaken the setting of AQL values for items of inspection and also a classification of

Firestone
GUIDED MISSILE DIVISION
QUALITY DEVIATION REPORT

To: Quality Control Dept.

Date: _____
From: _____
Dept: _____

I wish to report trouble that affects or may affect the quality of part or assembly. _____
(Name or Part Number)

Nature of Quality Deviation (Sketch If Necessary)

The following suggestions may help correct the reported trouble.

Q. C. Form 35

Figure 1

defects to describe quality standards. However, and unfornately so, the blueprint dimensions and specifications requirements established by engineering are the standards of quality for most quality control programs. The blueprints, in most cases, do not discriminate as to the importance of dimensions, for they include dimensions used to aid production as well as critical design dimensions; therefore, any quality standard based on the blueprint requirement will generally likewise not discriminate. It is necessary to establish economical standards of quality, taking into consideration engineering requirements, cost of achieving the desired quality, and production's capability of meeting schedules.

- *Determine if standards or goals are being met*

  Essentially this portion for the control of quality is performed by an inspection section or department together with the statistical quality control department. It is the job of inspection to appraise the conformance or nonconformance of the material or processes with engineering specification, whereas the statistical quality control group evaluates inspection results to determine conformance to the quality standard being controlled and to determine whether there has been significant changes from the standard which has been established.

- *Take corrective action when standards or goals are not met*

  This is the heart of any control procedure. If practical preventive or remedial action does not take place when standards are exceeded, then quality (or lack of it) is *observed—not controlled.*

Using the above three stages to define "control," this article describes the corrective action program and mechanisms developed by the author and his colleagues in the statistical quality control department, and used at the Guided Missile Division of the Firestone Tire & Rubber Co.

When the program was first initiated, the basis for standards were the engineering specifications and/or drawings. At that time, a classification of defects program was started, but it was not sufficiently complete to establish standards for the desired

Firestone
INTEROFFICE

TO

FROM QUALITY CONTROL DEPT.

REFERRING TO LETTER OF

SUBJECT QUALITY DEVIATION REPORT NO. _____

This is to acknowledge the receipt of your report of _____. Our department has scheduled time to investigate this report. We appreciate the interest which you have shown.

Signed: _____

Q. C. Form 36

asm

Figure 2

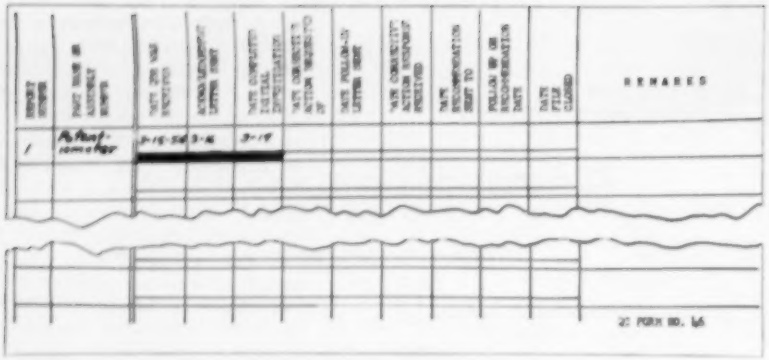

Figure 3

quality. Inspection appraised quality with respect to blueprints and specification requirements. Corrective action was informal and accomplished only after repeated rejects were found. A formal corrective action program became a "must" for preventing the reoccurrence of defects. The purpose of the formal corrective action program was to control material, processes, and workmanship which departed from specifications and/or drawings and to formalize corrective action to prevent like deviations from recurring.

The mechanism used to formalize corrective action is called the "Quality Deviation Report." The QDR (Quality Deviation Report) procedure is handled and administered by the statistical quality control department. Deviations from blueprints, specifications, and workmanship which are likely to cause recurring defects require QDR action. In a sense, production, inspection, engineering, and office personnel are asked to determine whether the standards or goals of quality are being met. By using their combined talents, the statistical quality control department has a greater opportunity of detecting those defects which are likely to repeat. It has been found that by asking personnel other than inspectors to report trouble, an avenue of quality expression is provided for all employees which has greatly increased quality consciousness throughout the plant. Of the total QDR's which have been processed to date, approximately half were received from personnel other than inspectors.

The procedure of initiating, processing, and "controlling" the QDR's is as follows:

- *The Quality Deviation Report is initiated.* This report (see Fig. 1) can be initiated by production personnel, vendors, inspectors, quality control, engineering, or office personnel. Employees are encouraged to submit a report when any type of "trouble" that is likely to repeat is encountered.

  - In filling out the report only three essential facts are requested:

    (a) The part or assembly name and number in question.

    (b) Trouble or Quality Deviation which is encountered.

    (c) Possible methods of eliminating the trouble.

  Here again great dividends have been reaped by making use of the knowledge of the persons filling out the report. It is reasoned that if an individual is able to discover trouble, he is often able to suggest methods of eliminating it.

- *The report is received by the statistical quality control department*

  - A serial number is entered on the report. This report number is the numerical order in which the report is received.

  - A letter of acknowledgement is sent to the report initiator. (See Fig. 2.)

  - A QDR Journal (see Fig. 3) is kept showing and controlling the progress of each QDR. At this time, the following is posted in the journal:

    (a) The report number

    (b) Part (or assembly name and number)

    (c) Date QDR was received

    (d) Date acknowledged letter was sent. (The acknowledgement letter is important because it points up to the QDR initiator that the organization is interested in quality and his cooperation is appreciated.)

  - The report is filed in what we call an initial investigation file by report number. (This is a file which visually indicates the QDR workload.)

- *A quality control engineer performs an initial investigation*

  - The files of previous QDR's with the same part name or number are pulled from the part file and reviewed. The part number file is a file of all QDR's which are written against a given part number.

Firestone
INTEROFFICE
TO QUALITY CONTROL DEPT. FROM _____
REFERRING TO LETTER OF
SUBJECT QUALITY DEVIATION REPORT NO. _____
The following corrective action is under consideration or has been taken:
Signed: _____
Date: _____
Q. C. Form 36
Enjoy the Voice of Firestone on Radio or Television every Monday Evening over N.B.C.

Figure 4

• The data on the QDR is checked with the QDR initiathe QDR, statistical quality if necessary are made.

Here again quality consciousness is built into our personnel. In verifying the data on the QDR, statistical quality control is given another chance to iron out misconceptions of quality control as well as investigate the QDR data for its accuracy. It is an excellent advertising medium to have a QC engineer where trouble is encountered. The initial investigation is an all important phase of the QDR, and it takes the greatest portion of time in processing a QDR. Having the QC engineer check the facts in the QDR often clarifies the reported trouble area.

• *If the QC engineer cannot undertake corrective action himself*

• A request for corrective action with a reply form (see Fig. 4) is sent to the appropriate Firestone department. The QC engineer investigating the QDR determines which department should take corrective action.

• The date and the department requested to perform corrective action is then posted in the QDR Journal.

• A copy of the QDR is sent to the department which is requested to perform corrective action.

Firestone
INTEROFFICE

TO

FROM QUALITY CONTROL DEPT.

REFERRING TO LETTER OF

SUBJECT QUALITY DEVIATION REPORT NO. _____

Our records show that we have requested corrective action on _____

To date we have not received any official word as to the disposition of our request. Will you please give this report your prompt attention in order to prevent further occurrence of the same trouble.

Signed: _____

Q. C. Form 37

Figure 6

• A tickler card (see Fig. 5) is placed in the follow-up file and two weeks is allowed for the corrective action to be undertaken.

• The original QDR is then filed in the parts number file.

• When the corrective action letter is returned to the SQC department:

(a) The tickler card is pulled from its file.

(b) Duplications of the recommendation of the corrective action letters are issued to the initiator of the QDR and departments directly concerned with the corrective action.

(c) The date and department to which recommendations were issued is entered on the QDR Journal.

(d) The corrective action letter is filed with the QDR in the parts number file.

• When the tickler card shows corrective action is overdue:

(a) A follow up letter (see Fig. 6) is sent to the department which was requested to perform corrective action.

(b) The tickler card is placed in the follow up file—one week being allowed for further reply as to corrective action contemplated.

• When the tickler card shows that the second request for action is overdue:

(a) Management is notified that corrective action has been requested from a department on two different occasions but no action has been taken.

(b) Management is then requested to effect some action to close out the QDR.

• Corrective action is undertaken and the file is closed out.

Report No. _____ DATE

1. Corrective Action Requested of _____

2. Date Action Due . . . . . .

3. Overdue Letter Sent . . . . . .

4. Overdue Action Due . . . . . .

5. _____ Notified of no Corrective Action . . . . . .

Figure 5

The above is a procedure that is being used successfully at Firestone Tire and Rubber Co. An instruction sheet by the statistical quality control department for reducing the above procedure to a routine is shown in Fig. 7.

It is felt that this corrective action system is one that encourages quality consciousness throughout all echelons of the plant's personnel. The QDR provides a definite channel of communication for the rank and file employees and their daily quality problems. It is surprising to see the enthusiasm toward the quality control program that is generated by the QDR. Under the old system the avenues of communication were open only to the inspectors and quality control engineers, but now they are open to all. After using the QDR system for approximately two years, we believe that there is no substitute for the personal contact and for the complete upward and downward flow of information which the QDR provides.

The QDR system is an information center for the statistical quality control department because it indicates quality problems. It also has a "built in" and effective corrective action mechanism that assures a successful follow up system to eliminate recurring defects.

STATISTICAL QUALITY CONTROL DEPARTMENT

Office Procedure for Quality Deviation Report

ACTION INITIATED BY		ACTION TO BE TAKEN	Part No. File	Reminder File	Initial Investigation File	Out Box
QUALITY DEVIATION REPORT	FILE CLERK	○ Post a serialized number on the report. ○ Send acknowledgement Letter. ○ Enter acknowledgement date in QDR Log ○ File report in its order. ○ File report No. in cross index file			→	→
INITIAL INVESTIGATION FILE ORDER	QC ENGINEER	○ Pull previous Quality Deviation Reports for the same part number and review past deviation. (Check cross index file). ○ Check with personnel initiating Quality Deviation ○ Report as to validity of data. ○ Determine methods of corrective action ○ Enter date initial investigation completed in QDR Log	→			
REQUEST FOR CORRECTIVE ACTION	FILE CLERK	○ Duplicate Quality Deviation Report. ○ Post date and Firestone Agency in QDR Log ○ File original Quality Deviation Report. ○ Send form letter and duplicate Quality Deviation Report to Firestone Dept. requested to perform corrective action. ○ File tickler card 2 weeks up.	→ →	→		→
RETURNED CORRECTIVE ACTION LETTER	FILE CLERK	○ Pull Quality Deviation Report. ○ Pull reminder card. ○ Consult with original investigator as to distribution of recommended corrective action letter. ○ Duplicate corrective action letter and Quality Deviation Report (if necessary). ○ Send corrective action letter to distribution. ○ Post date in QDR Log and to whom recommendations issued. ○ File Quality Deviation Report and corrective action letter.	→ →	→		→
REMINDER CARD IS OVERDUE	FILE CLERK	○ Send follow up letter to Firestone Agency requested to recommend corrective action. ○ File reminder card up one week. ○ Post date in QDR Log.		→		→
ADDITIONAL CORRESPONDENCE ON QDR	FILE CLERK	○ Pull file. ○ Consult with original investigator as to disposition. ○ File all correspondence.	→			

Figure 7

Some Uses of Statistics in Plant Maintenance

JAMES ARMSTRONG, JR.

E. I. du Pont deNemours & Co., Inc., Richmond, Va.

Introduction

It would probably be not too far from reality to say that many who are active in industry regard plant maintenance as a necessary evil, one which must be endured and which is being satisfactorily taken care of so long as production is not held up because of machine breakdowns. Evil or not, maintenance work is certainly costly as is evidenced by statistics from the chemical industry, where approximately ten percent of the employees are engaged in maintaining plants.

In the maintenance field, as throughout all branches of industrial effort, recent years have seen increasing use of the systematic study and evaluation of past performance for the purpose of finding means to accomplish future improvement. The use of statistical methods in such analyses seems to be coming more and more into play. It was a result of this general trend toward employing statistics to help solve industrial problems that led to the decision, at du Pont's Richmond, Va., rayon plant three years ago, to devote special effort to statistical study of our plant maintenance problems. This article will give brief descriptions of several specific instances where this work has proven valuable. It is believed that these examples typify, to a certain extent,

the fascinating and remarkable versatility of statistical tools.

Each of the examples to be discussed, occurred in conjunction with the manufacture of viscose rayon yarn, a process which involves dissolving cellulose xanthate, a product formed by the interaction of cellulose, caustic and carbon disulphide, into a caustic solution and then coagulating the cellulose back to a solid in the form of multifilament yarn. In one process, subsequent to its generation, each rayon thread is built up into a cake inside a rotating spinning bucket. These spinning buckets are mounted on vertical spindles of small electric motors which turn them at several thousand revolutions per minute. Centrifugal force causes the yarn to adhere to the bucket wall and form a cylindrical cake as it is fed into the bucket. The relatively high speed of bucket rotation puts a desired twist into the thread as it is collected.

We have several thousand of these high-speed motors in operation, replacing and repairing those which burn out or break up involves so much of our maintenance time and money that considerable effort is devoted to improving motor performance. How has statistics entered into this? Here are some examples.

I. The Chi Square Test

A. Two general types of motors are used. These motors differ essentially in the methods employed for dampening vibration. One type has internal provisions for dampening vibration and is rigidly mounted to the spinning machine frame. The second type is mounted on a flexible pad for vibration absorption.

In a certain period the motor positions in one of our spinning areas equipped with the two type motors had winding burnouts as shown in Table I.

Table I

Type Motor	No. Burnouts
Internal vibration compensation	68
External vibration compensation	406
	474

Since 25 percent of this area is equipped with the internally compensated motor, it is possible to calculate how the 474 burnouts would have divided between motor types, had each type performed equally, by apportioning that percentage to the internally compensated, the balance to the externally compensated type. Calculated performance is then compared with actual performance by means of Chi Square, the statistical coefficient of dispersion. (See Table II.)

Table II—Frequencies of Burnout Occurrence

Type Motor	Portion of Area	Actual (Fa)	Calculated (Fc)	Chi Sq. $(Fa-Fc)^2/Fc$
Internally Compensated	25%	68	118.5	21.3
Externally Compensated	75%	406	355.5	7.1
	100%	474	474.0	28.4

Chi Square tables show that for one degree of freedom the probability of obtaining a value as large as 28.4 is less than 0.0001, which is to say in this case, the odds against chance occurrence of difference in performance, from motors of equal capability, as wide as that above are greater than 10,000 to 1.

This could mean that vibration absorption, or rather the lack of it, is responsible for the relatively high burnout rate of the externally compensated motors, a possibility somewhat bolstered by comparing the performance of those motors of this type recently mounted on spinning machine frames with that of the motors which have run continuously for some time. Table III gives the data.

Table III — Frequencies of Burnout Occurrence (Externally Compensated Motors)

	Portion of Motors	Actual (Fa)	Calculated (Fc)	Chi Sq. $(Fa-Fc)^2/Fc$
Recently Mounted	57%	306	231.4	23.9
Run continuously	43%	100	174.6	31.7
	100%	406	406.0	55.6

Here again calculated burnout frequency on this type motor is based on the hypothesis of equal performance from the two classes of motors. Comparing actual and calculated frequencies produces Chi Square even more significant than that obtained in comparing the two different types of motors. It is possible that in the recently mounted motors, vibration is constrained and load is thereby increased so as to produce excessive burnouts, whereas with the motors which have run continuously there has developed sufficient loosening of the motor mounts to make more free operation and thereby less load in the motor.

Our motor repair costs will be reduced in the order of $50,000 per year if externally compensated motors can be made to perform as well as the internally compensated type. As an outcome of this statistical investigation a more efficient vibration absorbing mount for the externally compensated motor has been developed.

B. In making rayon an important feature of the process involves controlling the size (denier) of each thread produced. To assist in accomplishing this control, the amount of cellulose solution which goes into each thread of yarn is metered by a gear pump which has critical parts accurately made to one ten thousandth of an inch tolerances. Performance criteria for these pumps together with the tolerance limits within which they must deliver for proper control of yarn denier, have been established. All the pumps are tested at regular intervals and those not performing within tolerance limits are replaced and overhauled at considerable expense. In several instances statistical study of pump performance and test data has indicated means of reducing pump overhaul costs. One of these instances serves as another example of Chi Square test's use.

In one spinning area two manufacturing operators are engaged full time testing those cellulose metering pumps. It was suspected at one time that one of these men was, through a slight departure from standard test procedure, imposing a bias upon his test results which could result in faulty condemnation of pumps with resulting inflation of replacement and overhaul costs. Records of an equal number of tests made by the two men in the same period of time are analyzed in Table IV.

Table IV—Frequencies of Pumps Failing Test

	Actual (Fa)	Calculated (Fc)	Chi Sq. $(Fa-Fc)^2/Fc$
Operator A*	99	79.5	4.8
Operator B	60	79.5	4.8
	159	159.0	9.6

D.F. = 1; Prob. = 0.002

*Suspected to be using wrong procedure.

Here Chi Square indicates that the two operators could, from the same population of pumps, with the same

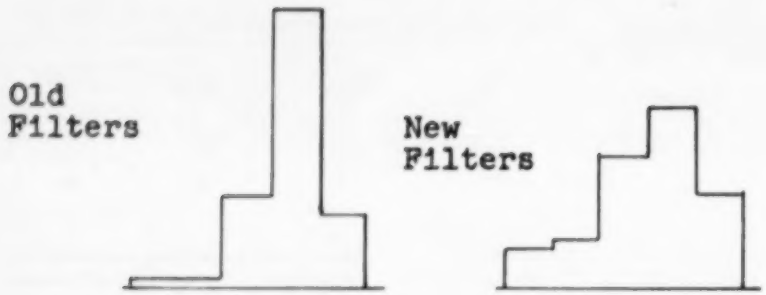

Figure 1—Effect of Filter Replacement on Pump Delivery Distribution

test procedures, obtain results as different as those exhibited only about twice in 1,000 series of tests. This data constitutes strong evidence that the difference in testing routine was affecting test results. When these facts were pointed out to the plant manufacturing group, differences in test routine were eliminated and the results from the two operators became comparable.

C. A final example of Chi Square's use developed in studying spinning bucket motor failures where it was suspected that motor performance was adversely affected by the frequent breaking of funnel shaped guides which introduce each thread of yarn into its bucket. Since data required for accurate evaluation of the correlation between the two variables, broken funnel guides-motor failures, was not obtainable, motor failures in four equal periods were compared with frequencies which would exist had the motors failed in proportion to funnel guides breaking in each period (see Table V).

Table V—Motor Failure Frequencies

Period	Actual (Fa)	Calculated (Fc)	Chi Sq. $(Fa-Fa)^2/Fc$	Funnel Guides Broken
1	117	115.5	0.02	190
2	93	92.5	0.00	152
3	89	92.5	0.13	152
4	97	95.5	0.02	157
	396	396.0	0.17	651

D.F. = 3; Prob. = 0.985

The statistical tables tell that chance alone will cause Chi Square to be a larger value than 0.17 ninety-nine percent of the time. This suggests something other than chance must be causing motor failures and broken funnel guides to follow one another in the manner exhibited. This has led to the analysis and control of guide failures as a means of improving motor performance.

II. Frequency Distributions

Frequency distribution study is another statistical technique which has been valuable in this work.

A. When it developed that the cellulose solution metering pumps mentioned earlier were performing much better in one of our spinning areas than in the other, an investigation was made to determine causes for the difference. It was discovered that the two areas were following different procedures in making the test by which pump performance is evaluated: where the pumps performed well, they were always tested when delivering through old filters; in the area where pump delivery was more erratic, tests were made with pumps delivering through new filters just installed. Apparently installation of new filters brings about a wider dispersion of pump deliveries, probably because resultant decrease in pump discharge pressure causes some pumps to deliver more, while incompletely filled filters, at the time of testing, result in other pumps delivering less. The data shown by Fig. 1, deliveries of a group of pumps with old and new filters, supports these suppositions.

As a result of these findings identical test procedures and tolerances are now used in the two plants with no increase in repairs.

B. One of our textile areas in which yarn is finished and prepared for shipment to our customers supplies another example of gain through frequency distribution study. There the yarn is run through an operation called slashing, which involves sizing, drying and finally winding the yarn onto a large spool which contains several hundred pounds of yarn when filled. In this spooling operation, the spools, or beams as they are called, which rotate at fairly high speed, frequently commence to run erratically, sometimes to the extent that yarn being wound on them is damaged. When this occurs, the operation is stopped and beams are doffed short of their intended load with resultant decrease in operating efficiency and increase in cost due to reprocessing involved. Poor condition of the beams and of machines on which they run are felt to be responsible for these rough running beams. Therefore, considerable effort goes into attempts to keep poor running beams at a minimum.

In studying this problem, a group of 147 beams reported as having run erratically during slashing were classified in accordance with the percent of full load on them when doffed, this data is shown in Fig. 2.

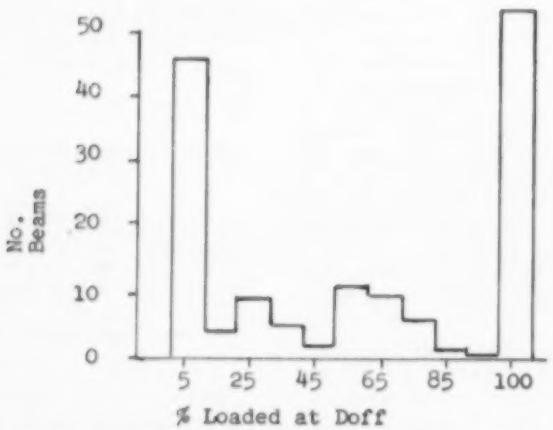

Figure 2—Rough Running Beams Classified by % Loaded When Doffed

A distribution of such an odd shape as this will usually have some logical explanation; such is believed to be the case here. First it was believed that the large quantity of

beams doffed at five percent of their load was caused by the relatively rough running of all beams at the start of the slashing cycle. The barrels of these spools in some cases are not smooth, as a consequence the spools run roughly at the start of the operation and it requires considerable judgment to estimate which beams will settle down with yarn build-up and which will continue to run poorly.

The equally large quantity which was allowed to fill completely, even though running poorly, is believed to be made up of beams which never behave quite bad enough to warrant pulling off the machine before completion of the run. The remaining portion of the distribution occurs in a rather normal fashion, smooth tapering to the extremes with the maximum quantity occurring essentially in the center.

With this information, it was decided to compare the four manufacturing shift crews with one another, particularly with regards to those beams doffed at five percent of intended load since there, as has been mentioned, the exercising of considerable judgment is required. Fig. 3 shows this classification of the data.

Chi Square was not needed to tell here that "A" shift was significantly high with respect to beams doffed at five percent of load while no better than other shifts in other respects. As a result of this study, there has been an almost complete elimination of beams stopped and doffed early in their cycle because of their poor running performance.

C. For a final example involving the use of frequency distributions, some time ago there developed considerable demand, due to excessive failures, for redesign and replacement of bearings in the electric motors driving machines on which one of our textile operations is performed. Failures of these bearings during the preceding 20 months were distributed as indicated by Fig. 4.

Practically all the demand for redesign stemmed from the high failure period.

Reference to tables of the Poisson distribution, applicable to data of this sort, revealed that there was a theoretical probability of 0.0074 of obtaining four or more failures in a month when the average per month is 0.75. While this probability is slight, it is not so slight as to warrant its being considered proof of the need for a $10,000 bearing replacement program. In view of this evidence, we recommended that the bearing change not be considered on the basis of the evidence at hand. The change was not made, there has been no occasion to consider it since.

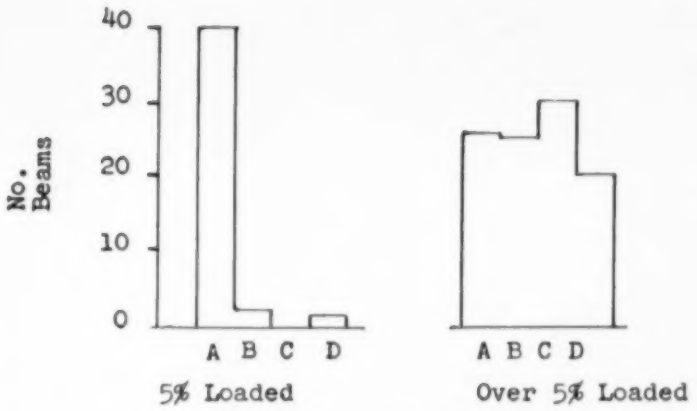

Figure 3—Rough Running Beams by Manufacturing Shifts

III. Sampling

As in quality control, sampling for percent defective has proven useful in maintenance work. This will be indicated by one of a number of instances where this technique has proven useful. In a program to recondition some of our purification equipment, when cost and continuity of production prohibited accurate determination of just what quantities of many different equipment parts were needed to effect the reconditioning, parts requirements were estimated through detailed examination of a random sample of equipment pieces. It seems that maintenance men are prone to overestimate material requirements on large scale overhaul jobs. In this particular program, on evidence furnished by the statistical sample, parts costing $31,000 were ordered. Upon their receipt some six months later they were adequate, were all used and served to put the equipment in satisfactory condition.

IV. Data Requiring No Analysis

Another benefit worth mentioning in this article is the savings sometimes derived through just the orderly collection of data. The following are two examples of this sort of thing. The first concerns one of our regularly scheduled maintenance overhaul jobs which involves removing an item of equipment from a manufacturing machine and replacing it with a like item which has been cleaned. A simple investigation revealed that this job was costing $60.000 per year, of which a major portion was the cost of equipment unavoidably broken in making the change. This cost figure, together with knowledge of the process, was sufficient to persuade all concerned

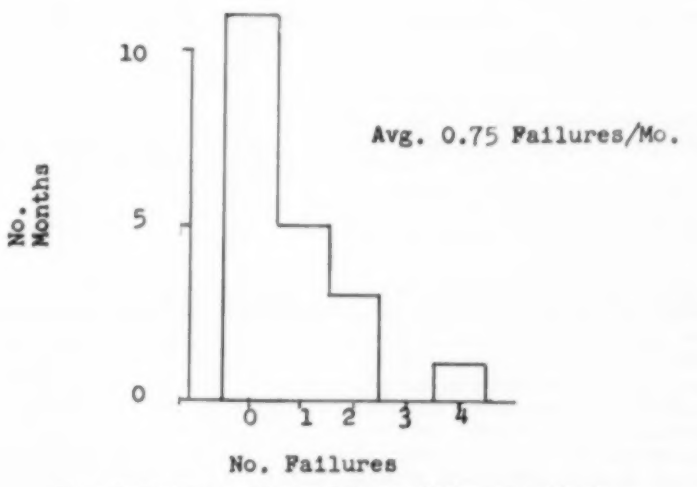

Figure 4—Distribution of Bearing Failures in 20 Consecutive Months

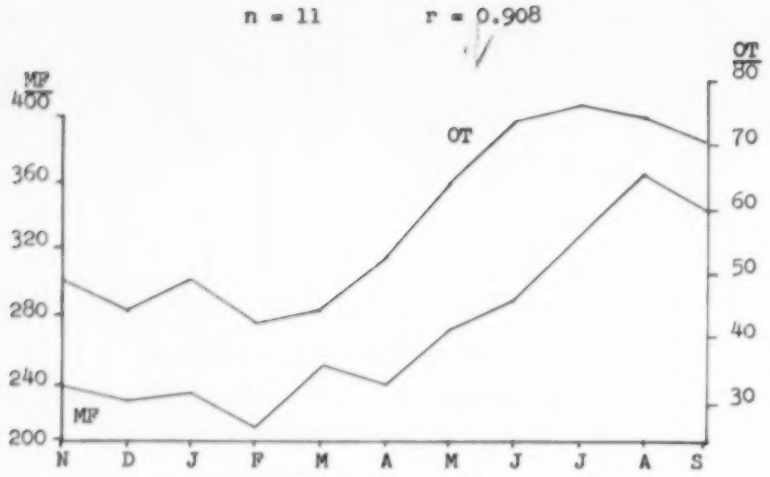

Figure 5—Motor Failures and Outside Temperature

that the overhaul frequency could be halved without affecting product quality.

A second example of gain through the mere collection of data occurred in an area where low machine efficiency was having an adverse influence on productivity. Data collected to determine lines along which desired improvement in mechanical efficiency might be obtained revealed that breakdowns were causing a five percent loss of machine efficiency. This, coupled with the fact that overall efficiency of the machines involved was only 60 percent, clearly indicated that no amount of money spent on improving maintenance would appreciably help the manufacturing group in performing its task.

While admittedly not derived through the science of statistics, I think that benefits such as these will accrue in any program where facts expressed in terms of figures are collected.

V. Correlation

A. Correlation analysis is a statistical tool which has proven extremely useful. After considerable study, the relationship between spinning bucket motor failures, in one area, and outside temperature, shown in Fig. 5, was discovered and verified statistically.

No apparent reason for this relationship was at first evident since the motors operate in an air conditioned room where temperature is fairly constant and there is but slight response to changes in outside temperature. Then it was postulated that a rise in outside temperature would result in a decrease in draft action generated in the plant fume stack. This decrease in exhaust air flow might result in a decrease in cooling air exhausted across the motors into the fume exhaust system. This supposition was verified by taking exhaust system air flow measurements at varying outside temperatures and establishing the fact that a relationship existed between air flow and outside temperature as shown in Fig. 6.

Measurements of motor temperatures showed them to be highest where air flows were least. Finally, when temporary circulating fans blowing on bucket motors brought about a decrease in failures of motors so treated, installation of permanent fans to circulate air over all the motors effected a considerable reduction in motor failures.

B. Several thousand units of one of our important production equipment parts had been in use for two years when some of the units began to fail because of an undiscovered flaw in internal reinforcement. By means of correlation analysis the loss in the average life of these parts which would be sustained because of the design flaw was predicted and proved to be of sufficient consequence to justify immediate redesign. Failure trends developed in this investigation have proven useful in forecasting replacement requirements, an important item since the part is vital to production and replacements must be ordered six months in advance of their need.

C. Multiple correlation was used in the investigation for the cause of variation in yarn moisture in our slashing area. These "wet beams" or spools of yarn containing too much moisture must be reprocessed before shipment. "Wet beams" were believed to be the result of poor drying caused by condensate flooding the steam drying cylinders. However, when investigation showed that the frequency of "wet beam" occurrence and the frequency of cylinder flooding did not correlate, it was realized that other factors entered into their cause and we were therefore reluctant to institute expensive alterations to the slasher condensate system.

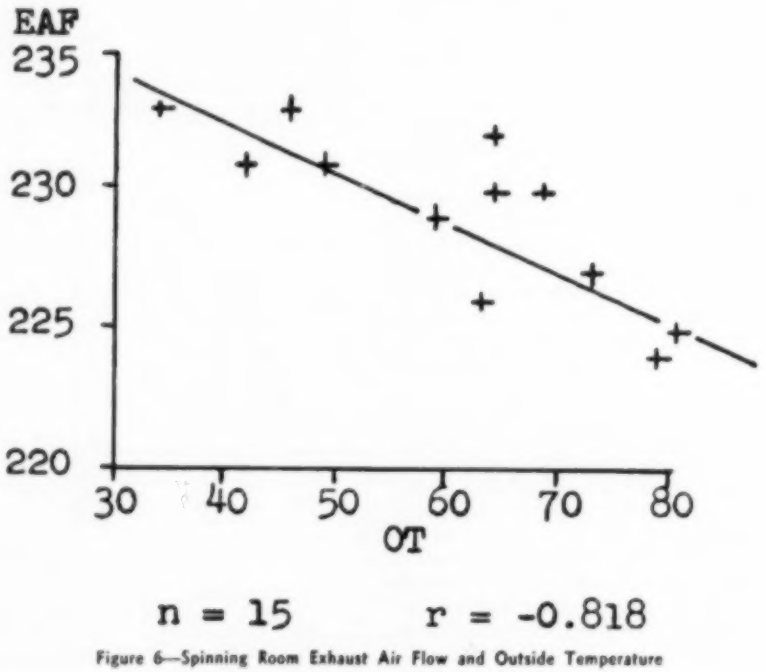

Figure 6—Spinning Room Exhaust Air Flow and Outside Temperature

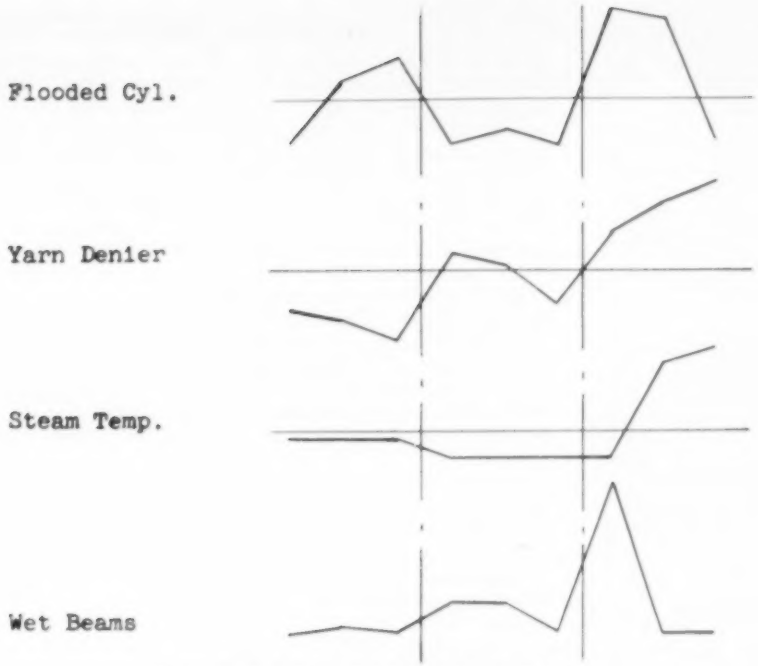

Figure 7—Wet Beams and Related Process Variables

Final control of yarn moisture is exercised by comparing the weight of the yarn on each beam with its theoretical weight at desired moisture content. Beams are shipped if yarn weights are within certain limits each side of theoretical—out of limit beams are reprocessed.

Multiple correlation showed that yarn denier variation played a large part along with flooded drying cylinders in causing "wet beams" to occur. A third factor, temperature of the drying cylinder steam, was found to have an effect about equal to the effects of denier and cylinder flooding in causing "wet beams."

Figure 7, presenting a highly condensed version of the data which was analyzed to obtain these conclusions, is intended to give a general idea as to how these three factors combined in their effect on the occurrence of "wet beams."

Letting
X_1 = Flooded cylinders
X_2 = Yarn Denier
X_3 = Steam Temperature
Y = Wet Beams,

it turned out that the regression equation for estimating Y was

$$Y = -1.6866 + 0.3260X_1 + 0.4520X_2 - 0.3851X_3.$$

By dividing the chart into three approximately equal chronological periods, it may be possible to see that during period (1) cylinder flooding was high but, with low yarn denier and nominal steam temperature, "wet beams" were not excessive. In period (2) the number of "wet beams" increased even though cylinder flooding was a low level, presumably this resulted from a denier increase and a drop off in steam temperature. In period (3) "wet beams" first skyrocketed, due to simultaneous rises in cylinder flooding and denier, then subsided with the drop off of flooded cylinders and rise in steam temperature.

These findings tended to explain the obscure causes of wide variation in the occurrence of "wet beams." They have led to a better understanding of our problems in controlling yarn moisture and to the decision that expensive redesign of drying cylinder condensate removal equipment is not required to obtain this control.

Conclusion

In outlining these various instances in which statistics has proved useful in studying maintenance problems, it is hoped that we have conveyed some conception as to how this science can be applied to any field where facts can be expressed numerically.

Local Section News

". . . BUT NOT FORGOTTEN"

ALBUQUERQUE On Nov. 7 a meeting was held at the University of New Mexico. An educational session was presented by G. J. Lombardi, Sandia Corp., who completed a discussion of mixed attributes-variables sampling which was started at the previous meeting. The topic for the general meeting was "Management's relationship to quality control." The speaker was Louis Kahn, vice president of the Aerovox Corp.

BALTIMORE The executive committee held a meeting Nov. 9 to formulate future meeting plans and our phase of the Middle Atlantic Conference, which is to be held in Washington, D. C., Feb. 10-11.

D. H. Taylor of the Bendix Aviation Corp. was guest speaker at our Nov. 16 meeting. Mr. Taylor's subject was "Adapting some fundamentals of charting and sampling to meet your needs."

BINGHAMTON On Nov. 10 at the Vestal American Legion, Vestal, N. Y., C. E. Fisher, executive secretary of the society and associated with the Bell Telephone Labs, spoke to the section on the subject "The quality assurance at the Bell Telephone Labs." About 85 persons attended and all comments on Mr. Fisher's talk were very appreciative.

BIRMINGHAM At the Nov. 10 meeting, J. Alfred Davies of General Electric Co. gave a talk on "Variables sampling without calculation." He outlined a new procedure for determining acceptable limits of quality variation which eliminates costly calculations of averages and quantitative deviations. The procedures Mr. Davies described have been approved by the military and are soon to be published for the public by a national committee in industrial quality control.

Over 100 people attended the all day quality control clinic held in Chattanooga, Tenn. on Nov. 4.

An educational course has been started at the University of Alabama. So that the students will receive information on specific applications of SQC as well as theory and methods, several members of the section will discuss applications of SQC at their plants.

BUFFALO No matter how careful our meetings are planned, we find one of them that "Weathers-out." Our latest was the plant tour thru the Dunlop Tire & Rubber Co. which had been scheduled for Nov. 28. Last year our Nov. 29 meeting with Leon Bass as guest speaker was cancelled because of the weather.

BURLINGTON In place of the regular monthly meeting, several members participated actively in the Ninth New England Conference which was held at the Hotel Statler, Hartford, Conn., Nov. 3-5. Chet Gadzinski was program chairman for the conference and R. W. Hooley spoke on "Aircraft casting quality control." A. R. Thomas and C. F. Murphy were session moderators.

BUZZARDS BAY W. F. Hoehing, manager of the production and material control dept. of Westinghouse Electric Corp., Pittsburgh, addressed a joint meeting with the Rhode Island section on Nov. 15 on the subject "Statistical Inventory Control." His talk covered the application of statistical methods to the store's inventory control problem of amounts of inventory to order at optimum times. Cases were cited to show that ordering time is determined according to a service criterion based on a number of stock outages.

Edward Rudnick, American and Canadian sales representative of the O-M Spinning Machine Co. of Japan reported on a recent one month visit to Japan textile mills. He indicated that statistical quality control techniques in Japanese manufacturing concerns are much more widespread and common than at similar plants in this country.

Over sixty people from New Bedford, Fall River, Providence and Attleboro were in attendance.

CHICAGO The section's 10th annual two day training course in QC was held on Nov. 7-8 at the Hotel Sherman. As in the past, response to the offering of this course was splendid with a final total registration of 241 persons. Upon completion of the course, 117 students applied for membership in the Chicago section. At the luncheon meeting of top management executives held on Nov. 8 in conjunction with the course, Joseph D. Stockton, vice president of the Illinois Bell Telephone Co. spoke to the executives and students on "How quality control helps solve administrative problems." His talk enabled top executives to better understand the workings and advantages that can be obtained through the use of QC techniques. This first attempt of such a gathering was very successful. A total of 500 persons attended this luncheon. The entire program was under the guidance of Charles Matz, educational committee chairman. To Mr. Matz and his co-workers we extend sincere thanks for their efforts.

The second dinner meeting of the Calumet sub-group was held on Nov. 15 at Zarante's Restaurant in Calumet City. A general discussion of various problems encountered in the application of SQC techniques to chemical and metal fabricating processes proved to be very interesting and informative.

CLEVELAND The November meeting was held at the Cleveland Engineering Society and featured Dr. Acheson J. Duncan of Johns Hopkins University. In his talk on "Economical design of control charts," Dr. Duncan presented several short cuts in the use of charts for quality control. An interesting aspect of Dr. Duncan's talk was his method for evaluating the cost of investigating the various factors that go into the use of control charts.

The first of three courses in quality control sponsored by the section has been completed and was well received. It was conducted by Charles Kendal, chief inspector at the Lamson & Sessions Co. Mr. Kendal was the former section chairman.

COLUMBUS On Nov. 16 Derrill B. Pratt, Jr., technical director, Omar Baking Co., Inc., spoke to the members of the section following a tour of the local bakery. In his talk Mr. Pratt covered raw materials testing, vendor certification and market research problems associated with his industry.

CORNING -ELMIRA Burr Stanton, of the General Electric Co., spoke before approximately 100 members at the Nov. 8 meeting. Mr. Stanton discussed "Selling quality control to the factory." He showed many of the films and slides used by the General Electric Co. in their quality control training program.

DALLAS -FORT WORTH "A successful program relative to the establishment of quality control functions in woodworking industry" was expertly outlined and explained by Charles Latimer, Nickey Brothers, Inc., Memphis, Tenn., to members and guests at the Nov. 10 meeting.

DANVILLE -SUNBURY The annual management night was held Nov. 16 at Bucknell University with 20 persons attending. W. W. Spencer, General Electric Co., presented a very interesting talk on the management of quality control functions.

DAYTON The third regularly scheduled meeting of the section was held Nov. 10 at Delco Products Div. of GMC. The speaker was Wm. MacCrehan of the Bendix Radio Corp., Baltimore, Md. whose topic was "Consumer vendor relations." A large percentage of the membership was in attendance at this meeting and enjoyed Mr. MacCrehan's talk very much as noted by the number of questions directed to him following the talk.

DELAWARE The second regular meeting of the season was highlighted by a most informative talk by E. C. Harrington, manager of industrial statistics of the plastics division of Monsanto Chemical Co. at Springfield, Mass. Ed's talk on "Response surface experimentation" outlined many advantages in the design of experiments over the traditional factorial design, in that equal information on the effect of variables can be derived from fewer experiments.

ERIE On Nov. 9 Stanley E. Jacke, development engineer, Detrex Corp. spoke on "Ultrasonic systems for metal cleaning." As a climax the Soniclean process was shown by means of a portable demonstrator. Many members brought in samples to be cleaned. This was a very impressive as well as interesting presentation. We strongly urge program chairmen looking for something "different" to contact D. E. Williard, 14431 Woodrow Wilson, Detroit 32, Mich.

GEORGIA "Quality control in novelty food business" was presented by Barney W. Hilton, head food technologist, H. W. Lay & Co., Inc., Atlanta, at the third monthly meeting held Nov. 29. In telling of the application in this food business, he explained the success was due to the management accepting the responsibility for quality, with the production doing the quality work, and the laboratory leading the way within the cost limits. A brief social period followed during which potato chips, peanuts, etc., from H. W. Lay & Co., were enjoyed along with popular local soft drinks supplied by Harry Fewox.

GREATER MUSKEGON The section had a panel discussion as part of the program for the dinner meeting on Nov. 10. After a family style dinner of chicken or ham (or both) full stomachs had no deleterious effect on the active interest taken during the discussion. The panel was capably moderated by Merrill Bailey of Anaconda Wire & Cable Co. Other members of the panel whose topic was "Three problems in quality control" were Ray Porter, Muskegon Piston Ring Co. and Roland Byer, Keller Tool Div., Gardner Denver Corp.

HARRISBURG The featured speaker at the November meeting held in the Yorktowne Hotel in York, was William MacCrehan. Mr. MacCrehan showed himself to be a very dynamic speaker and those present certainly came away with a fresh approach to many quality control problems.

HARTFORD The monthly meeting was held as usual at the Rockledge Country Club, West Hartford, Conn. on Nov. 11. The subject "Difference between quality control and inspection" was discussed by a qualified panel of experts and was followed by a general discussion from the floor. More of these panel discussion type of meetings will be planned for the future.

On Nov. 3-5 the section was host to the Ninth New England Conference. The conference was deemed a success and very enlightening to those attending. Local plant tours along with classroom lectures pertaining to quality control were offered.

At the executive board meeting held in November, it was announced that Erwin Schiesel of the Mattatuck Mfg. Co., Waterbury, Conn. and Wm. MacCrehan of the Bendix Radio Corp., Baltimore, Md. have agreed to speak at one of the regular monthly meetings to be held sometime early this year.

KANSAS CITY The largest group of the year attended the November dinner meeting. Members and guests heard Glen S. Goodman tell of the remarkable gains in automatic machine product quality resulting from the use of statistical quality control at McQuay-Morris Mfg. Co. of St. Louis.

LINCOLN The November meeting of the section consisted of a plant tour of the Grand Island Furnace & Supply Co. Following the tour, F. W. Jessen, of the host firm, gave a fine presentation.

LOS ANGELES The November meeting program was presented by personnel of McCullough Motors, Inc. Representatives of management, engineering, manufacturing, sales, and inspection participated in the discussion of maintaining quality control by committee.

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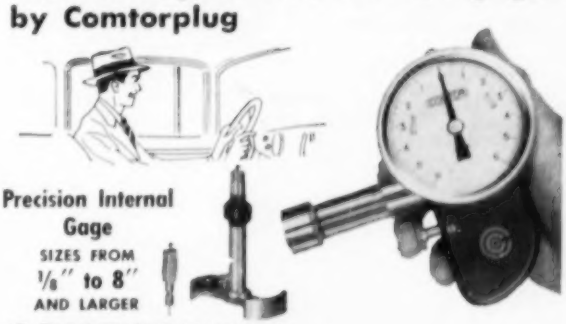

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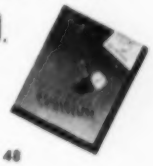

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METROPOLITAN A panel discussion on the "Integration of quality control within the organizational structure" was the highlight of the Nov. 15 meeting. F. Bruce May, director of quality control for Johnson & Johnson, described the line and staff type quality control organization of his firm. B. W. Thomas, assistant superintendent of quality control for Western Electric Co. discussed the "quality audit" which is used at Western Electric. Francis Dupress, superintendent of assembly production for Kollsman Instrument Co. discussed the role of inspection at his firm. Dr. Paul C. Clifford, Montclair State Teachers College, led the discussion period. C. J. Keyser, Bell Telephone Laboratories, presented "Control charts for defects" during the pre-meeting clinic.

MICHIGAN "Quality control applied to accounting" was the topic of the Nov. 15 meeting held at the Rockham Building in Ann Arbor. The speaker for the evening was Howard L. Jones, general supervisor of statistics, Illinois Bell Telephone Co.

MICHIGAN
Flint Subsection The first meeting of the season was held on Nov. 10. The speaker was Clarence Burdick of the Houdaille-Hershey Corp., Detroit. Mr. Burdick's topic "Quality control—now and the future" was thought provoking and stimulating. Following his talk, Mr. Burdick opened the meeting for general discussion, and it was evident from the interest engendered that another meeting in the spring would be worthwhile. There were 20 in attendance at the meeting with a very large delegation representing various Saginaw industries.

MICHIGAN
Wolverine Subsection On Nov. 4 a group of 50 members and guests met at Post Cereal's Clubhouse in Battle Creek. Harmon Bayer, quality control consultant and Fellow member of the society, was guest speaker. Dr. Fred Beeler of Western Michigan College conducted an educational session on the control chart for variables preceding the regular meeting.

MILWAUKEE The 10th Midwest Quality Control Conference will not be forgotten for many years to come—517 participants will testify to that. This conference had many highlights. The pre-conference gathering at Pabst Blue Ribbon Hall was enjoyed by all. The clinic sessions were excellent—statistically we were in control as the distribution of the interest was evidenced by the attendance of the sessions. Onr pioneer professorial friends, Drs. Burr, Craig, Henry, Kowler, Olds, and Wescott were in their usual exquisite form with a dash of dry wit. The Thursday luncheon, "SQC—past, present and future" was reminiscent of the past ten years of progress and offered our part in the challenging future. The 10th anniversary party was a "'jim-dandy." This was without a doubt, the most comical entertainment ever offered at a Midwest conference. As the final frosting to the 10th anniversary cake, Ed McFaul presented an unsurpassed luncheon talk "How confused can you get?" and brought down the rafters. Wish you were there? You should have been. You really missed a terrific conference.

MINNESOTA Dorian Shainin, vice president of the society, was the speaker at the Nov. 10 meeting. A very good turn out was on hand to hear his talk on "100 percent inspection—its strengths and weaknesses."

MONTREAL An excellent dinner meeting was held at the LaSalle Hotel on Nov. 16. Over 30 members were present, as well as some guests, to hear J. C. Knapp of the Ford Motor Co. of Canada speak on "Managing quality." With the help of slide illustrations and a recorded commentary, Mr. Knapp gave an instructive and constructive picture of techniques of QC used at the Ford Motor Co., much of which can be applied elsewhere.

NEW HAVEN On Nov. 8 James J. Dolby of the General Electric Co. was guest speaker on the subject of "Engineering for inspection." Mr. Dolby's interesting presentation was well received by the members and guests .

NORTHEASTERN INDIANA The meeting held Nov. 10 at the Plantation, Auburn, from the standpoint of attendance alone was an outstanding success—158 reservations for the dinner having been paid two days prior to the meeting. Credit for attendance goes to membership chairman L. A. Erickson, General Electric Co., and his committee along with H. A. McAninch, chief engineer of the Warner Automotive Parts Div. of Borg-Warner Corp., sponsor of the Auburn meeting. Wendell Phillips, quality control manager, Ford Tractor and Implement Div., Ford Motor Co., speaker of the evening, delivered a well-rounded out and practical talk to an enthusiastic group of management and quality control people. He very deftly carried his audience through the procedures of establishing a practical and workable quality control program beginning with the need for defining quality in a specific product and concluding with the pay-off. After this meeting, the sponsor conducted guided tours through the plant.

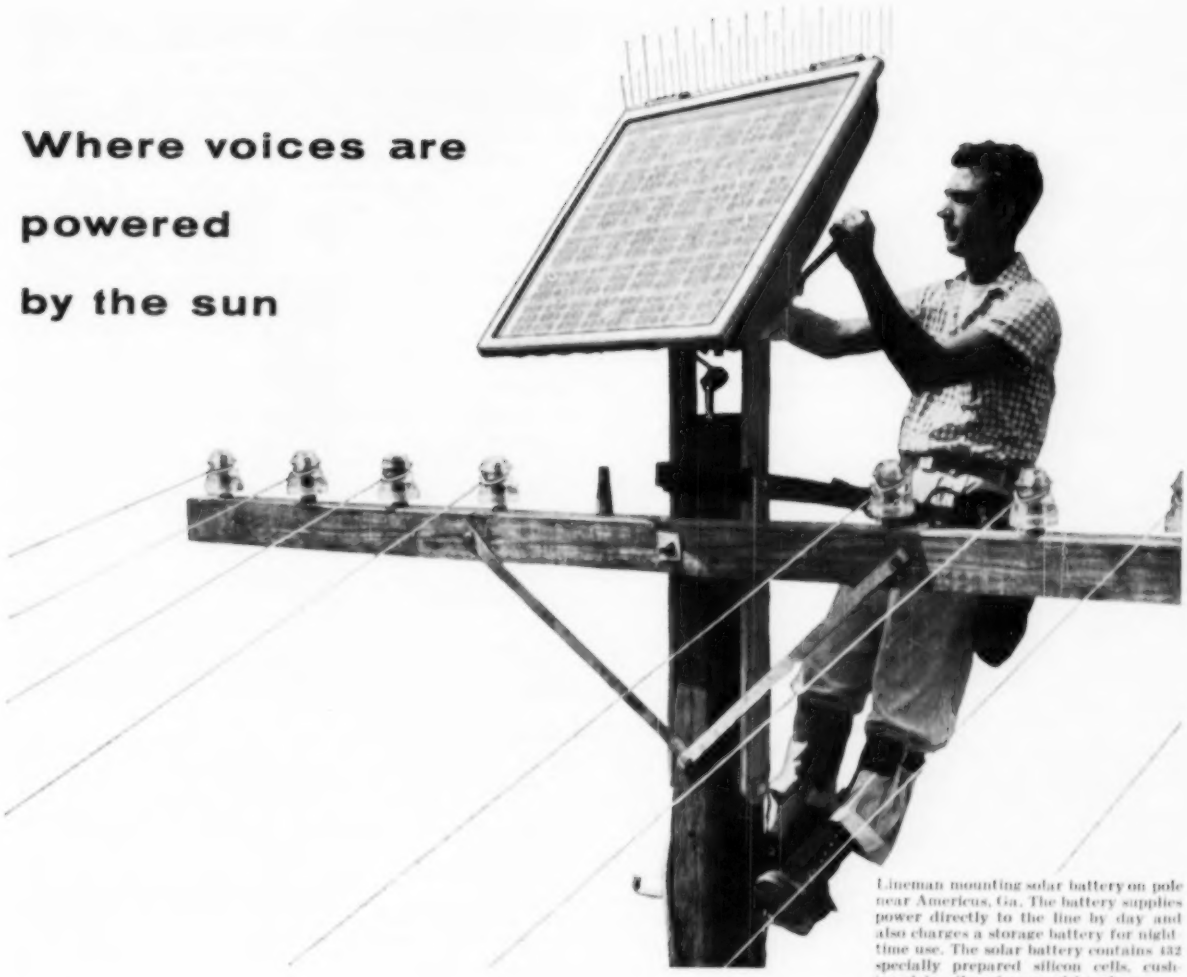
Another good speaker on QC subjects in the making! The section's own Jack Mader, test engineer, Magnavox Co., did a splendid job in a 15 minute talk on "The moving range of two" at the November meeting. This is an educational feature of each of our section meetings.

PHILADELPHIA Dr. Joseph Juran, management consultant, spoke to a near capacity crowd of ASQC, ASTM, and ASWOMEN engineers. His topic was "A blueprint for installing quality control."

PITTSBURGH The Nov. 22 meeting was to have been Prof. I. W. Burr's presentation "Statistical considerations involved in preparing and understanding specifications for industrial products." Due to Dr. Burr's unfortunate accident returning from the Midwest conference, Prof. Ed Olds of Carnegie Tech graciously substituted on very short notice and spoke on this same subject to an overflow audience.

PITTSFIELD Featured at the regular monthly dinner meeting held in the Stanley Club, Pittsfield on Dec. 1 were two interesting talks by section members. Dr. Lawrence Spooner of General Electric, discussed the uses of probability paper, and George Lyman of Peter J. Schweitzer, Inc., spoke on loss con-

Where voices are powered by the sun



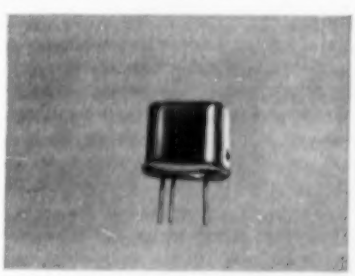
Lineman mounting solar battery on pole near Americus, Ga. The battery supplies power directly to the line by day and also charges a storage battery for night time use. The solar battery contains 432 specially prepared silicon cells, cushioned in oil and covered by glass.

A new kind of telephone system developed by Bell Telephone Laboratories for rural areas is being operated experimentally by electric current derived from sunlight. Electric current is generated as sunlight falls on the Bell Solar Battery, which a lineman is seen adjusting in position.

The exciting achievement is made possible by two Laboratories inventions—the solar battery and the transistor. The new system uses transistors to the complete exclusion of electron tubes. Transistors require little power and this power can be easily supplied by the solar battery.

Compact and economical, the transistorized system can carry several voices simultaneously without interference. It has proved its ruggedness by standing up to heat, cold, rain and lightning. It promises more and improved telephone service for rural areas and it typifies the Laboratories' continuing efforts to make American telephony still better each year.

In sending and receiving terminals, transistors are used as oscillators, amplifiers and regulators, and for signaling.



One of the transistors (actual size) used in the new system. New ideas, new tools, new equipment and new methods had to be developed for this project.

BELL TELEPHONE LABORATORIES

IMPROVING AMERICA'S TELEPHONE SERVICE PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

trol in the paper industry. There was a good turnout for dinner and the talks; it was felt that development of speakers from within the group is a valuable practice which should be continued in the future.

Many members of the section were in Hartford, Conn. for the recent New England conference. Fred Hartwell, section chairman, was seminar chairman for the conference and our delegation included a speaker and several exhibitors.

ROCHESTER At the November meeting R. W. McEwen of the McCurdy & Co., Inc., Rochester, N. Y. spoke on the subject "Looking over the retailer's shoulder." He presented the retailer's viewpoint of the manufacturer's quality control program. The talk was very well received by those present.

ROCKFORD Warren E. Alberts, director of the industrial engineering department of United Air Lines addressed the annual management night meeting on the topic "Operations research—a challenge." The talk was illustrated by slides showing current operations research projects at United Air Lines.

ST. LOUIS The section and the Purchasing Agents Association of St. Louis had an exceptionally fine joint meeting on Nov. 22 with two presentations being made by A. D. Foote, works purchasing agent, Allis-Chalmers Mfg. Co. and W. Kohl, quality control engineer, Allis-Chalmers, on quality and quality control of purchased materials. The section presented its exhibit of educational devices which were used at the Midwest 10th annual conference at Milwaukee. An exceptionally large attendance of over 200 persons were out for the meeting and dinner.

SALT LAKE G. G. Parkin, stff consultant, industrial statistical control, Minnesota Mining & Mfg. Co., St. Paul, Minn., spoke on "Tests of significance in industrial processing" at the Oct. 27 meeting.

SAN BERNARDINO Bernhard Hecht, quality control consultant and a founding member of the society, was the principal speaker at the Dec. 1 meeting. Mr. Hecht's talk, entitled "Tailoring quality control programs to fit different companies" was well received by the 58 members and guests who attended the dinner meeting.

SAN FRANCISCO BAY AREA On Nov. 10 the section met with the National Canners Association, Division of Statistics, and U. S. D. A. Western Research Laboratory at a special dinner meeting climaxing the week-long course "Statistical quality control for the canning industry" conducted by the latter two organizations. Principal speaker was Bill Hudson, vice president of Gerber Products Co. and vice president of National Canners Association. Mr. Hudson presented very aptly management's viewpoint on the values offered a company by a SQC program. He stressed the importance of basic salesmanship, sound objectives, realistic budgeting, and periodic progress analysis by quality control people in building the confidence and backing of management during the planning and proving stages of an industrial quality control program. Enough to say the meeting was a memorable affair.

SCRANTON -WILKES-BARRE Our regular November meeting, held in Wilkes-Barre, was proof of the interest in quality control, by the large group present. The speaker of the evening was Major D. M. Randall, USAF, chief of quality control division, directorate of procurement and production headquarters, Middletown Air Material Area. Major Randall gave an interesting and enlightening talk on "Air Force quality control policy." He also referred to a series of illustrative charts to bring out some highlights of QC policy. His talk was followed by a question and answer discussion between the speaker and the group.

SEATTLE "Statistics, statistical education, and quality control in Latin America" was the subject of a talk by Dr. Grant I. Butterbaugh at the November meeting. Dr. Butterbaugh presented a review of the International Statistical Institute conference held this past summer at Petropolis, Brazil and related meetings held with men in various South American countries and what they are doing in the field of statistical quality control.

SOUTHERN CONNECTICUT Sherman Kingsbury, a mathematician with Arthur D. Little, Inc., Cambridge, Mass., was the principal speaker at the annual management night meeting Nov. 9. His topic of the evening was "What operation research means to you." The event was well attended and Mr. Kingsbury's talk was well received. Another feature of the meeting was the presentation of the fourth place prize in the Saddoris Award for section management, won by the section for 1954-55, to chairman Edward W. Demers by Ervin E. Schiesel, society treasurer, of Mattatuck Mfg. Co., Waterbury, Conn.

SOUTH TEXAS On Nov. 9 Robert Harvey, executive general manager of Prudential Insurance Co. of America, Houston, introduced the section to a new field. Mr. Harvey spoke on "Improving the quality of office operations," a field in which Prudential has pioneered. As was expected, the turnout was large since the subject included such functions as accounting, purchasing, sales, material handling, and other functions which require repetitive clerical operations. Preceding the meeting, E. S. Aldredge talked to another full house in the training section. Ed's subject was "Basic statistical calculations."

STATE UNIVERSITY OF IOWA John L. Gable, State University of Iowa section, of the Collins Radio Co. is conducting a course in basic quality control techniques at Coe College. Topics included in the course are basic statistics, variables control charts, attribute control charts, and acceptance sampling procedures. Present enrollment is 14 students representing six different industries in Cedar Rapids and Amana. The pupils are primarily inspectors though the class also includes two electronic technicians, one production and one inspection foreman, and one time study man.

TENNESSEE The Tennessee, Birmingham, and Chattanooga sections sponsored an all day clinic at Chattanooga on Nov. 4. Speakers discussed problems in the paper, textile, and foundry industries, plus applications in education.

TOLEDO The November meeting of the section was held at the Maumee Yacht Club. Dr. E. D. Harrison, dean of engineering at Toledo University talked on the subject "Modern Engineering."

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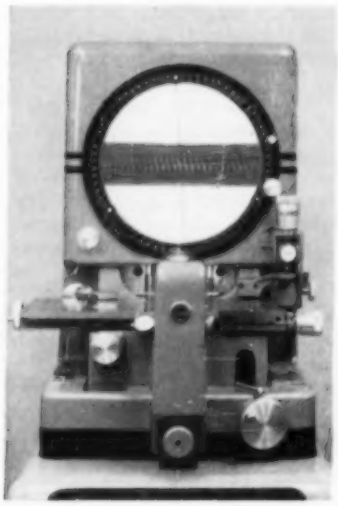

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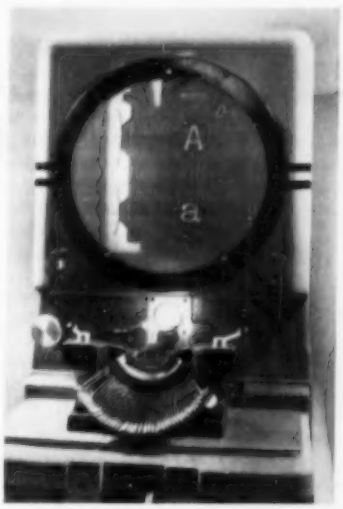

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The QC educational session was conducted by Nelson Meagley. His subject was "Distribution analysis." Three Toledo technical societies joined to make this meeting a success. The societies involved were ASQC, AIIE, and ASME.

TORONTO On Nov. 2 at our regular meeting we enjoyed the lecture on work sampling given with a sprinkle of wit and wisdom by W. D. Davidson, B. N. A. Holding, Ltd., Toronto, Canada.

Approximately 25 members enjoyed a pleasant tour of the Loughton Ave. plant of Canadian Industries (1954) Ltd., on Nov. 16. The tour was arranged through the courtesy of W. E. Denmark, works manager, and Mr. Carother, chief engineer.

WESTERN MASSACHUSETTS Our Nov. 15 meeting was held at the Sheraton-Kimball Hotel in Springfield, Mass., and was attended by 25 members and seven guests. The speaker, Kenneth L. Killer, chief industrial engineer of U. S. Time Corp., spoke on "The developments of labor standards for quality control." His talk developed the subject of cost versus quality and he gave indications as to how the cost of quality could be measured. Such interesting questions were answered as what returns from customers can a business tolerate; how are these returns related to repair and replacement costs; what effect does this have on customer goodwill. Generally speaking, Mr. Killer's talk was predicated on the basis that QC must be based to achieve the lowest possible field returns. He also developed the idea that before control could be achieved there must be strict surveillance of tools and equipment and a complete understanding as to the process capability.

The intermediate statistical quality control course being sponsored by the section will be completed during the first week in February. The high respect for this course is evidenced by the fact that of the 55 students starting there were, after the halfway point in the course, still 48 attending.

WICHITA The monthly meeting was held at the El Charro Dining Room on Nov. 1. Ernest Ochel of Boeing, Charles O'Neil of the Coca-Cola Co., and Fred Gades of the United Cement Co., were the speakers. The subject of their talks was "What management thinks of quality control." There were approximately 160 members and guests in attendance.

WINDSOR Deland Davis, chief chemist of Post Cereals Div. of General Foods, Battle Creek, Mich., addressed the section at the Nov. 9 meeting held at Assumption University, Windsor. The talk was most stimulating, pointing out many methods of applications of quality control. Thirty four members were in attendance.

WINNEBAGO The November meeting of the section was held at Fond du Lac. The principal speaker for the evening was Arnold Jackel, consultant, Milwaukee. His topic was "A systematic approach to process control." Preceding the dinner meeting, an introductory course in quality control was conducted by Robert Lace, who substituted for Carl Noble. Mr. Noble was unable to attend the meeting due to business.

WORCESTER Roy G. Volkman of the U. S. Rubber Co., Providence, R. I., presented a talk on "An Acceptance control chart" at the Nov. 17 meeting. This was an area meeting held at the Nipmuc Rod & Gun Club, Upton, Mass. and sponsored by Draper Corp., Hopedale, Mass. There were approximately 65 people that attended the meeting. Refreshments were served after the talk.

YOUNGSTOWN The Package Electric Div., GMC in Warren, Ohio was a fine host to the section providing them with an excellent dinner and the use of their well equipped auditorium for the technical session. L. E. Pogue, moderator for a panel type meeting did an excellent job in getting several members to present their favorite control chart and lead the group discussion.

"... CAST THEIR SHADOWS BEFORE"

ALBUQUERQUE The Feb. 6 meeting will consist of an educational session on "Tolerances from stacked tolerances." The speaker will be J. M. Wiesen, Sandia Corp. The topic for the general program will be "Engineering's relationship to quality control." Dr. Cledo Brunetti is tentatively scheduled as the guest speaker. The meeting will be held in Mitchell Hall, University of New Mexico, at 7:15 pm.

BINGHAMTON The next meeting will be held on Feb. 22 and will be the annual joint dinner with the Technical and Engineering Council of Southern New York at which the section will act as host. Arrangements are now being made to bring in a nationally famous speaker for this affair. This is also a ladies' night which gives the women a chance to see where the men spend all their time.

BIRMINGHAM On Feb. 9 Paul W. Runge, superintendent of technical department, Chemstrand Nylon Plant, Decatur, Ala., will deliver a talk "Quality control at Chemstrand." (Chemstrand is a subsidiary of Monsanto Chemical Co.) After five years experience as metallurgist at Carnegie-Illinois, Mr. Runge has had eight years experience in various chemical supervisory capacities with Monsanto and Chemstrand.

BURLINGTON On Feb. 15 at the Pavilion Hotel, Montpelier, R. W. Hooley of the University of Vermont's department of commerce and economics will speak on the subject of "Quality control and the paperwork function." Examples of applications to insurance problems will be included in this methods session.

CHICAGO At the next afternoon and dinner meeting on Jan. 25, Eugene G. Freund, corresponding secretary of the section and manager of quality control at the Victor Adding Machine Co., will speak on "Incoming materials quality control." Mr. Freund will discuss control techniques, classification of defects, and methods of quality assurance and their application at Victor. The evening speaker will be a man nationally known for his consultant work in QC, Leonard A. Seder. Mr. Seder's topic will be "Consumer vendor problems."

On Feb. 15 the second of a group of plant tours arranged by our plant tour committee will be made through the Zenith Radio Corp. Format of the tour will be a talk on the application of quality control techniques at Zenith given by a member of that plant.

In conjunction with the general meeting, those who have completed the 16 week training course will be

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awarded their diplomas. The course was sponsored by the section and conducted by the following members of the advanced educational committee; Dr. Marjorie Sutherland, Mae Goodwin Tarver, Eleanor Shlifer, Martin Joseph, Harry H. Hull, William Lieberman, C. B. Herschberger, Florence Powhely and Raymond Swendson. To this committee and their graduating class, sincere congratulations on the completion of your endeavors.

CLEVELAND Ervin E. Schiesel of the Mattatuck Mfg. Co. will be the featured speaker at the Feb. 3 meeting to be held at the Cleveland Engineering Society. Dinner will be at 6:30 pm and the regular meeting will start at 8 pm.

COLUMBUS The annual management dinner meeting will be held at the Deshler-Hilton Hotel on Feb. 16 at 6:30 pm. L. D. Gable, general manager of Timken Roller Bearing Co., Columbus plant, will be the principal speaker and his talk is entitled "A plant manager looks at quality control." At this meeting certificates of completion of the section's training program will be presented.

CORNING -ELMIRA The next meeting will be held in Elmira on Feb. 14. Warren R. Purcell, a consultant from Rath & Strong, Boston, Mass., will speak on "Quality pre-control—a new tool for long and short runs."

DANVILLE -SUNBURY Dr. William Carr of the Bucknell University faculty will be the speaker at the next meeting of the section which is to be held Wednesday, Feb. 15. Dr. Carr's topic will be "The psychology of quality control."

DAYTON The first of two regularly scheduled meetings will be held on Jan. 26. This meeting will consist of a plant tour at Airtemp Div., Chrysler Corp., in the afternoon. E. E. French, chief inspector at Airtemp, will give a talk.

The second meeting will be held Feb. 9 at Delco Products Div., GMC. The speaker for this occasion will be Dr. A. V. Feigenbaum of the General Electric Co. who will talk on "Management of the QC function."

DELAWARE The Feb. 9 meeting will be held at the Lord De La Warr Hotel and will be marked by a talk by Dorian Shainin on the subject, "Controlling the quality of management decisions." Members—please note especially that this meeting is on the second Thursday of the month instead of the usual first Thursday. This change was made to suit Dorian's convenience.

ERIE In February, we will be conducted on a tour of the Bucyrus-Erie plant. At this time, final plans are still in the making. All members will receive adequate notice when final plans have been made.

GEORGIA Dr. George M. Brown of the mathematics department of the Georgia State College of Business Administration, Atlanta, will explain "Some theory of runs" at the regular meeting of the Atlanta group to be held Jan. 31, Room 1833, Hurt Building.

GREATER MUSKEGON Section chairman Chas. C. Duff, Anaconda Wire & Cable Co., has announced that the February meeting will be "Ladies' Night." This is an annual affair which is looked forward to by the wives and sweethearts.

HARRISBURG The February meeting will be held at "Hostetters" in Mt. Joy and will feature an education committee panel discussion. A program of this type proved to be of considerable interest to all last year and hence is being repeated.

KANSAS CITY The Feb. 8 dinner meeting will be held at the Blue Hills Restaurant. The guest speaker for the meeting will be J. Y. McClure, manager of quality control, Convair Aircraft, Fort Worth, Texas. His subject will be "Simple quality control—it's benefits to men and management."

LINCOLN The next meeting of the section will be held Friday, Feb. 10. A panel discussion entitled "Installing QC in an industry" is the feature of this meeting.

LOUISVILLE Ford Motor Co. has moved into a new, modern plant in Louisville. The section will have the opportunity of inspecting this plant Feb. 13. Our meeting will consist of a tour of the plant and a talk by our host, Earl H. Peterson.

MICHIGAN A dinner dance and meeting is scheduled for Jan. 21 at the Park Shelton Hotel. A special talk designed for the ladies entitled "The distaff side of quality control" will feature Dr. E. C. Yehle of the University of Michigan. Members and guests are invited to make plans early for this event.

"Discovery sampling" is the title of a talk to be given on Feb. 17 by Ervin F. Taylor. Mr. Taylor is supervisor of the quality control analysis section of North American Aviation, Inc. The meeting will be held in the Science Hall at Wayne University, Detroit.

MICHIGAN Wolverine Subsection A meeting is scheduled for Feb. 3 at Post Cereal's Clubhouse, Battle Creek. "Frequency distributions and process capabilities" will be discussed by Deland H. Davis, manager of quality control for the Post Cereals Div. of General Foods Corp.

MILWAUKEE Dr. M. E. Mundel, vice director of the Marquette Management Center will speak at the Feb. 20 meeting. His topic will be "Administrative applications of quality control." Those who heard Dr. Mundel present the keynote address at the 10th Midwest conference know that he has a lot of good material to offer.

MINNESOTA The next meeting will be on Feb. 21 and should be of great interest to all who have prcblems with visual inspection. The subject will be "Setting visual standards by photography," and the speakers are Armond Stoefen and Art Cunnien of the Toni Co.

MUNCIE W. C. Vissing, chief statistical inspection department, control division, Eli Lilly & Co., Indianapolis, Ind., will speak on the topic "Control charts" at the Feb. 16 meeting beginning at 7:30 pm.

NEW HAVEN On Jan. 26 the section will hold a joint dinner meeting with the Society for the Advancement of Management (SAM) at the Colonial House, Hamden, Conn. Thomas A. Budne of Philip Morris and Co. will present a quality control talk on "Practical tips on sampling." A similar joint meeting was held last year, and proved to be very successful.

PHILADELPHIA At the February meeting, the Philadelphia police department, represented by Inspector R. Selfridge, will advise section members on the statistical methods in use in crime statistics.

PITTSBURGH On Jan. 24 D. C. McCune of the Jones & Laughlin Steel Corp. will address the section on the subject of short-cut statistical methods.

PITTSFIELD On Feb. 2 Prof. Alfred W. Jones of Rensselaer Polytechnic Institute will address the section at its monthly dinner meeting in the Stanley Club, Pittsfield. Prof. Jones's topic will be operations research.

ROCHESTER On Feb. 7 Richard A. Freund of the Eastman Kodak Co. will speak on the subject "A method of rating quality."

ST. LOUIS At the next meeting, the section is in for an unusual treat through the courtesy of the management of the Ford Motor Co. who will play host for a complete tour of their local Mercury plant—one of the finest equipped for manufacturing assembly equipment now available in the automotive industry.

Arthur Bender, Jr., president of the society, will visit St. Louis for our annual anniversary meeting Feb. 17. In addition to participating in the celebration of the anniversary, he will present his paper entitled "Kwik-see."

SALT LAKE The first speaker for the new year will be George B. Brown, general supervisor of metallurgy, Columbia-Geneva Steel Div., United States Steel Co.

SOUTHERN CONNECTICUT The Feb. 8 meeting will have as its speaker D. N. Smith, manager of research engineering, Jones & Lamson Machine Co., Springfield, Vt. His subject will be "Application of the pre-control technique." This concept advances the possibilities of automatic quality control. Behind the originator of this concept it should be of interest to all concerned with the manufacture of machined parts and its application as applied to their plants. The meeting will be held at the Stratfield Hotel, Bridgeport, Conn. with dinner at 6:30 pm followed by the meeting at 8 pm.

SOUTH TEXAS The Feb. 8 meeting will pack a one-two punch. Two guest speakers will be on hand to assure a potent evening. G. R. Kehn will speak on "Chemical plant application of multiple correlation" and L. D. Pahnke will speak on "Statistical design of chemical plant experiments." Both men are associated with E. I. du Pont at Orange, Texas.

The training session preceding the meeting will be conducted by C. F. Lewis of Cook Heat Treating in Houston. Charlie's subject is "The uses of probability paper."

TOLEDO The next meeting is again scheduled at Angelos. The speaker will be Dr. Yehle, University of Michigan. A. Gates, container division, Owens-Illinois, will conduct the usual educational session on the subject of "Specifications vs. control chart limits."

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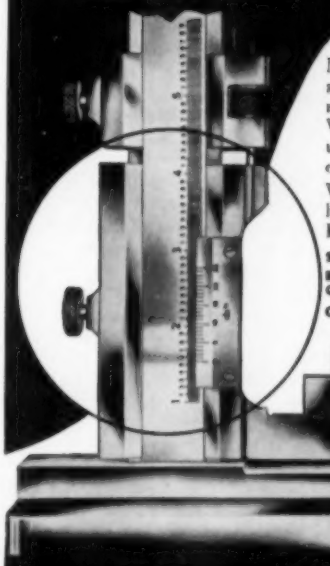

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TORONTO At our regular meeting to be held on Feb. 1 we will have as our guest speaker Miss Mary M. Torrey, Bell Telephone Laboratories, New York, N. Y. Miss Torrey's subject will be "Continuous sampling plans."

WICHITA Harry S. Corbin, president of the Wichita University, will be the principal speaker at the Feb. 7 meeting. Mr. Corbin will address the group on "Quality and quantity of higher education." Mr. D. E. Hillman will be moderator for Mr. Corbin. He will conduct a question and answer session following Mr. Corbin's talk.

WINNEBAGO The February meeting of the section will be held in Green Bay. This meeting will be the anniversary meeting of the section and plans are being made to make this meeting an eventful one.

WORCESTER R. Shaw Goldthwait, director of quality control at Collyer Insulated Wire Co., Pawtucket, R. I. will be the speaker at the Feb. 16 meeting. His subject will be "Quality control at Collyer."

YOUNGSTOWN On Feb. 9 Dale L. Lobsinger, supt. of QC, United Air Lines, Denver, Colo., will discuss "Customer-vendor relationships." Arrangements are being made to hold this meeting in Warran and a large turnout is expected for Dale's talk.

"AS YE SOW . . ."

BALTIMORE The section is planning seminars to introduce the advance techniques of both sampling and stratified sampling. These seminars are under the direction of Dr. A. J. Duncan of the Johns Hopkins University.

In addition, the University of Baltimore and Loyola College are offering courses in all phases of statistics.

COLUMBUS On Feb. 7 a panel discussion entitled "How to install a quality control program" will be held at the Southern Hotel. A week later the educational program will be completed with a panel discussion "How to administer and supervise a quality control program."

DANVILLE -SUNBURY Over 20 members of the section have enrolled in the quality control training course which will be conducted at Bucknell University. The course is to be conducted every other week and will last for ten weeks.

GEORGIA The section will cooperate with the Georgia Institute of Technology in sponsoring a course in basic quality control on Monday nights for 11 weeks, beginning in January and taught by Donald S. Holmes.

Georgia Tech will offer a short course in quality control for eight days during the later part of January.

MINNESOTA The section is sponsoring two training courses in quality control. An educational seminar on experimental design consisting of eight two-hour weekly sessions will begin Monday, Feb. 6. Prof. J. E. Bearman of the University of Minnesota will be moderator of the seminar. The second is an elementary training course similar to the one last year and will be held in late February.

ALL-DAY CLINIC FEBRUARY 21 The Twelfth annual all-day clinic to be sponsored by the Rochester section will be held on Tuesday, Feb. 21 at the Chamber of Commerce Building. A well-rounded program consisting of some 20 speakers will present talks on different aspects of the following subjects; statistical quality, ordnance, research and engineering, quality control and industrial engineering, quality control management, and general interest subjects. This promises to be an excellent opportunity to hear what nationally known experts have to report on these various subjects. The program committee has been particularly fortunate to obtain Raymond Fogler, assistant secretary of the Navy, to speak at the dinner.

You won't want to miss this clinic! If you have not received your copy of the program, please contact John F. Englert, 853 Washington Ave., Rochester 17, N. Y.

ALL-DAY CONFERENCE FEBRUARY 11 Plans are rapidly being completed for the first annual all-day quality control conference conducted by the San Bernardino section at Mission Inn, Riverside, Calif. on Saturday, Feb. 11. A program of broad general interest is being planned, with a minimum amount of detailed technical methods, and a maximum quantity of subjects of interest to supervisory and management personnel. Speakers of national reputation have accepted invitations to conduct this program.

FOURTH PACIFIC NORTHWEST QC CONFERENCE The fourth Pacific Northwest quality control conference sponsored by the Seattle section is scheduled to be held Mar. 9-10 at the University of Washington. The theme "Quality control in scientific management" will be well presented with educational training sessions and programs.

All interested persons are requested to write to Dr. Grant I. Butterbaugh, College of Business Administration, Seattle 5, Wash. for full particulars.

MIDDLE ATLANTIC CONFERENCE—AIRCRAFT DIVISION MEETING The 1956 Middle Atlantic Conference and Aircraft Division Meeting will be in Washington, D. C. at the Shoreham Hotel, Feb. 10-11. The conference is being sponsored by fourteen sections of districts 3, 5 and 6 and the Aircraft Division.

Four concurrent series will be offered in the areas of education, industrial applications, administrative applications and applications specific to the aircraft industry.

Subjects dealt with in the educational series will be: use of training aids, SQC training techniques, use of mid-range and median charts, alternatives to the analysis of variance, advantages and limitations in the use of the range, characteristics of the control chart for fraction defective, and quality control—from laboratory through production.

Subjects discussed in the industrial applications panel will include: applying the standard chi square significance tests to plant problems, fundamental concepts and purposes of specifications, statistics underlying the development of a procurement plan for the joint armed forces, statistics in the physical sciences, use of sensory test panels in controlling quality, continuous sampling, controlling quality for short runs, process control through frequency distributions, and aspects of process capability studies.

Areas covered by the administrative applications panel include: how the quality control engineer can use operations research, statistical techniques in the office, controlling inventory and production in the face of uncertain sales, sampling applied to accounting problems, settling inter-company accounts on a sampling basis, probability sampling, and work sampling. One of the high lights in this series will be a panel discussion concerning "Quality control experience in other countries."

Of utmost interest will be the series of sessions devoted solely to the application of quality control to problems of the aircraft industry. Subjects discussed will concern; quality control without a paper work empire, reliability—what it is and how it can be practically approached, estimating inspection costs, rework and scrap control in terms production can understand, and surveillance inspection and requirements for the contractor.

Each of the four concurrent series will have at least one open forum type of panel discussion with the usual informative question and answer sessions.

Of particular interest to the wives will be the attractive Ladies Program. Planned activities include: luncheons, a fashion show, sight seeing in the nation's capital, a musicale and tour of the White House.

The versatility of the program, the wonderful activities planned for the ladies, the excellent facilities of the Shoreham Hotel and the beautiful city of Washington, all add up to a conference you do not want to miss.

It is suggested that those who are traveling south to attend the textile quality control conference in Charlottesville, Va., Feb. 13-15, start out several days early and stop in Washington for the 1956 Middle Atlantic conference and a pleasant week end before proceeding on to Charlottesville.

For further information write: 1956 Middle Atlantic Conference—ASQC, 921 17th Street N.W., Washington 6, D. C.

SOUTHERN CONNECTICUT The section's educational program is scheduled to start Jan. 23 for the Stamford and Bridgeport area. The instructor for the Stamford course will be capable Howard Levenson, quality control director for Burndy Engineering Co., Norwalk. The Bridgeport course will have as its equally capable instructor Leonard A. Caplan, chief quality control engineer of U. S. Time Corp., Waterbury. With such top notch men as instructors all signs indicate to a highly successful educational program. The SQC courses offered will stress its basic concepts and their applications to industry in this area.

WICHITA The section members are all looking forward to the start of an educational program to begin Tuesday, Feb. 14. The proposed program is made up of elementary statistical theory, acceptance sampling, process control, and management reports. Members of the section who are specialists in their field will instruct the classes with the help of other technical people of the Wichita area.

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Mr. Grant Baldwin, Engineering Personnel

ROCKETDYNE

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YOUNGSTOWN Chester Smith and his educational committee have completed arrangements to give a ten week instruction course on the basic fundamentals of quality control. Meetings will be held in the Packard Electric Auditorium. The program will provide the average inspector, foreman, or production superintendent with a working knowledge of some of the statistical techniques which he may use in his work.

GEORGIA TECH'S QUALITY CONTROL BY STATISTICAL METHODS A course in "Quality control by statistical methods" will be conducted at the Georgia Institute of Technology, Mar. 5-13. For application or further information write; C. H. Taylor, coordinator, short courses and conferences, Georgia Institute of Technology, Atlanta, Georgia.

QUALITY CONTROL BY STATISTICAL METHODS UNIVERSITY OF ILLINOIS The ninth annual short course in "Quality control by statistical methods" will be offered by the college of engineering, University of Illinois with the cooperation of the Division of Engineering Extension at Urbana from Mar. 19 through Mar. 29. Intensive work will be given in the fields of control charts and acceptance sampling with some attention paid to the rational setting of specifications and tolerances. It is designed for those in the areas of design, production, procurement management, quality control and inspection.

For further information, write to: Professor John A Henry, Mechanical Engineering Laboratory, University of Illinois, Urbana, Illinois.

MANAGEMENT SYMPOSIUM APRIL 10-11 A "Symposium for management on applications of analog computers," sponsored by the Midwest Research Institute in cooperation with technical societies, will be held at the University of Kansas City, Apr. 10-11. For information write Midwest Research Institute, 425 Volker Blvd., Kansas City 10, Mo.

"FOR MANY ARE CALLED, BUT FEW ARE . . ."

BINGHAMTON Treasurer Robert Kiley and secretary Gordon Lucas have both resigned to take new positions. Their replacements are Joe Jirauch as treasurer and Fred Jarrett as secretary. Good luck to the departees in their new undertakings and welcome to the new appointees.

BURLINGTON At a recent meeting of the executive committee, R. W. Hooley was appointed to fill the unexpired term of office of vice chairman occasioned by the transfer of Dan Lundvall.

DIVISIONS

Chemical Division

The divisional council met in Ann Arbor, Mich. on Sept. 16-17. Highlights of the meeting are as follows.

- Dorian Shainin has advised us that the chemical division is now covered by liability insurance through the national headquarters. The policy covers all official functions of the division as well as its officers and members while engaged in society or division activities.
- Leon Bass requests the assistance of the division in locating and promoting advertisers for *Industrial Quality Control.*
- The division should take an active part in recommending nominations for the Shewart and Brumbaugh awards.
- A meeting room for the exclusive use of members has been arranged at convention headquarters to be held at Montreal, Canada.
- The education committee is making good progress towards the sponsorship of a conference on the Boxonian technique.

The questionnaire sent to the membership early in 1955 was returned and the final tabulation was printed in the Chemical Division News, Vol. II, No. 1, Oct. 15. It is interesting to note that of the 372 questionnaires that were mailed, 106 were returned. The response, therefore, amounted to 28.5 percent. The information contained in the questionnaire will be summarized in greater detail for use by the officers and various committee chairmen involved.

Textile Division

The date of the sixth annual textile quality control conference to be held at the Institute of Textile Technology, Charlottesville, Va., has been changed from Feb. 9-11 to Feb. 13-15 to avoid conflict with the Middle Atlantic regional conference which is scheduled for Feb. 10-11 in Washington, D. C. The date selected makes it convenient for those desiring to attend the Cotton Research Clinic, National Cotton Council, Feb. 15-17, to go directly to Pinehurst, N. C. from Charlottesville, Va.

MEMBERSHIP CORNER

The Toronto section has experienced ten years of rise and fall of interest in quality control. The conclusion has been reached that in a large city it is not sufficient just to have a broad range of interest reflected in its annual program. More aggressive action is necessary to attract new members and retain old ones.

Educational efforts are undoubtedly the most powerful means of securing new members. The Toronto section has co-sponsored the "Course in statistical quality control" presented by the extension department of the University of Toronto for some ten years. An educational meeting put on by this section in London, Ontario, in 1951, was the start of the University of Western Ontario section. A series of educational lectures sponsored by the section this year in St. Catharines, Ontario, is drawing attendances of close to 60. The resulting interest promises subsection status there very soon, with a new section likely to follow not long after. Thus, in spite of loss of members to the new Hamilton section this July, the membership is fast approaching the level of a year ago.

How to consolidate gains in membership and reduce the turnover—that is the question that has always bothered this section. This year more attention than ever is being given to the welcoming of members and guests at the door. It is not sufficient to hand out pocket cards to show the person's name. It is the word of welcome and the friendly attitude that make guest and

member alike feel they are among friends where they can learn not only from the speaker but also from those around them.

An incentive to old members to renew and for new members to join is the series of plant visits for members. Thus, to the advantages of membership in the society is added the privilege of touring industries already using SQC.

Are there any other ways of persuading a guest to become a member? Each guest this year is receiving a letter of welcome from the membership chairman, and with that letter is enclosed the year's program—and an application form! Results are appearing in the steady increase in membership.

One of the most potent means of securing the attention of industry has been the all-day forum organized yearly since 1954. With efforts focussed on service and education more than on the solid rattle in the treasury, the two past forums brought in many people not previously reached by ASQC literature. The forum planned for Mar. 10 will undoubtedly surpass in results those preceding it.

And what feature attracted one-third of the attendance? The educational session, of course.

SIGNIFICANT DIFFERENCES

The membership drive of the Birmingham section has resulted in membership as of Nov. 1, 1955 of 54 members as compared with 30 on Nov. 1, 1954. This is an increase of 80 percent over the 1954 figure or nearly 50 percent more than the adjusted membership as of June 30, 1955. The drive is continuing in an effort to approach the goal of doubling the section's membership.

Dan Lundvall, quality control engineering supervisor at General Electric Co., Burlington, Vt., has been transferred to the Schenectady, N. Y., operation as QC engineering manager. Dan has been active in the Burlington section, acting as vice chairman, industrial liaison and arrangements chairman.

The Cleveland section is sponsoring the formation of a "subsection development committee" whose purpose is to encourage and assist the development of new subsections. The first task of this committee is to consider the proposal of a subsection in the Mansfield, Galion, and Marion, Ohio areas.

Phillips E. Porter, Columbus section treasurer, has assumed the duties of chief inspector, Borg-Warner Corp., Wooster, Ohio, in addition to his previous duties as QC engineer.

John Harder, formerly QC manager at pilot plant #2 of the Corning Glass Works, has been promoted to chief process and quality engineer at the company's plant in Bradford, Pa.

Several members of the Dallas-Fort Worth section attended the Nov. 28 meeting of the newly-formed Waco section, Waco, Texas. D. D. Edgar, QC representative, Convair, Fort Worth, was guest speaker. The subject of his paper was "Vendor quality control."

Philip Green resigned the position of publicity chairman of the Danville-Sunbury section to take employment in Utica, N. Y. Burnett Tyson was elected to fill the unexpired term.

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HARRY W. DIETERT CO. / Control EQUIPMENT

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Robert G. Mitchell, chairman of the Delaware section, has recently been promoted to QC manager in charge of all company quality control activities of the International Latex Corp. Leroy W. Miller assumed Bob's former duties as quality control manager of the Dover, Del. plant. These men have the congratulations and best wishes of the section for continuing success.

Al Aubin, membership chairman of the Hartford section, was recently appointed to the quality control staff of Royal Typewriter in Hartford.

Chet Govang, chairman of the section, was recently promoted to the post of director of quality control at Gray Mfg. Co., Hartford, Conn.

Dr. C. W. Sandern, manager of quality control for Warner-Lambert Pharmaceutical Co. and member of the Metropolitan section, presented "Economics of raw material quality control" at the mid-year meeting of the American Pharmaceutical Manufacturer's Association.

The November issue of the *Magazine of Standards* features an article entitled "Are concrete specifications adequate?" by Edmund A. Pratt, consulting engineer, Berkely Heights, N. J. In this article Mr. Pratt, Metropolitan section member, explores the significance of strength specifications for cement concrete from a probability standpoint.

Another member of the Metropolitan section, Dr. Harold K. Hughes, Celanese Corp., has recently been appointed as technical superintendent of extrusion of the Celriver plant.

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There is no question but what every organization, whether technical or social, has attendance troubles. In order to maintain good attendance, M. G. Pugh, Northeastern Indiana section chairman, and his council determined to establish good attendance habits by planning programs of interest, whereupon an out-of-town program was suggested by a member of the council and immediately found favor with the group.

A sponsor was immediately appointed to get the ball rolling. Consequently, the Warner Parts Div. of the Borg-Warner Corp. became the co-sponsor of the meeting held in Auburn, Ind. on Nov. 10.

It was also recognized that even though we had an appealing program, a good place to eat and hold our meeting, a good speaker, and a plant tour, the effectiveness of fliers and newspaper publicity would not be enough to encourage all of our members to attend. The membership committee and the council did the rest by talking enthusiastically to every member and person interested in QC and asking these people to attend.

Ordinarily, if a section has an attendance at a regular meeting of from 25 to 50 percent of its members, it is thought good. But when you boost your attendance to 250 percent, it is noteworthy.

Therefore:

a. Plan the meeting well
b. Inject something unusual
c. Sell the project in an enthusiastic manner

The results obtained will speak louder than ordinary publicity.

The Philadelphia section has completed the first known wage survey of quality control members. Distribution has been made to 500 people around the country. The survey includes analysis of salary vs. age, experience, education, job title, company size, defense or commercial type of product, and various combinations of the above.

Those wanting copies may contact the author: R. M. Jacobs, Radio Corp. of America, Bldg. B-2, Camden, N. J.

Charles E. Ellis, charter member of the Seattle section, has been appointed chief, quality control division, USAF, in Chatauroux, France.

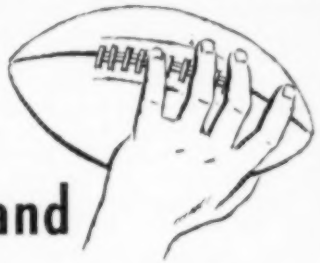
Charles R. Sheaffer, chairman of the Seattle section, was the main speaker at the November dinner meeting of the Seattle chapter of the American Institute of Industrial Engineers. Hus subject was "What is statistical quality control" and was followed by a film on quality control.

The November dinner meeting of the Puget Sound section of the Institute of Food Technologists featured two members of the Seattle section. E. Terry Dalton, past chairman, and Charles R. Sheaffer, chairman, spoke on "Organization and method; and Examples of statistical quality control applications" as applied to quality control of frozen foods at Stokely-Van Camp, Inc.

A. Henry Morgan, has been named to the post of general manager of the Gorn Aircraft Products Co., Stamford, Conn. Mr. Morgan, a member of the Southern Connecticut section, was formerly in the management consultant field.

Considerable attention has been given at the past two South Texas executive meetings to membership. First

In Packaging



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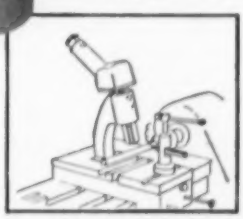

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of all, the vital statistics: 51 members as of Nov. 1, 1954; 57 members as of Nov. 1, 1955; membership renewals as of Nov. 1, 1955, 82.76 percent.

To meet our goal of 75 members for the 1955-56 year, letters have been sent to the addresses of the Texas Manufacturing Association and in addition, a number of personal calls have been made to prospective members or to company officials where, it was felt, new members could be solicited.

An all-out drive was made to keep non-renewals as low as possible. To this end, chairman Jerrold Moyer assigned each executive committee member with either one or two names of the non-renewals to be contacted personally and to secure the renewal or, if possible, to find the reason "why." Mr. Moyer intends to follow up and secure a tabulation that might be of interest to the society nationally.

H. L. Witz, director of products control of General Mills, Minneapolis, announced that R. C. Settergren, products control manager of the Rossford, Ohio plant and member of the Toledo section, has been appointed chief chemist of the General Mills Feed Div.

Fred P. Schliebner, Toledo section member, has been named manager, quality control, Her'rand Div. of the Bingham-Herbrand Corp. at Fremont, Ohio. Fred replaces G. Fromer who became factory manager of the division. Mr. Schliebner was formerly at Willys-Overland Forge Div. and Spicer Div. of Dana Corp.

Robert M. Lynas, Michigan section member, has been appointed assistant division industrial engineer for the Michigan division of Thompson Products, Inc. in an announcement made by W. H. West, chief industrial engineer for the division.

Walter A. Stadtler has been appointed director of manufacturing engineering for IBM Corp. Mr. Stadtler was formerly manager of the IBM Technical Services Laboratory at Poughkeepsie, N. Y. Mr. Stadtler is a member of the Mid-Hudson section.

Bibliography

JOSEPH MOVSHIN, *Editor*

Assisted by the Editorial Committee, St. Louis Section, ASQC

APPLICATION—METALLURGICAL INDUSTRY

STATISTICAL METHODS IN METALLURGY, by Ulick R. Evans, University of Cambridge
Metallurgia—v. 52, n. 311, Sept. 1955, p. 107-11)

The statistical evaluation and interpretation of metallurgical data is outlined in some detail.

Validity tests such as the t-test and chi-square are noted as is the use of and interpretation of correlation data. The use of histograms, frequency curves and their ogive to represent data is presented. Where normality cannot be justified, the author indicates the use of the Tchebycheff's and Camp-Merdell inequalities to estimate limits.

STATISTICAL CONTROL IN STEEL PRODUCTION, by R. T. Howard
(Metal Progress—v. 68, n. 2A, Aug. 15, 1955, p. A122, A123)

This article is a digest of "Quality Control—Use of Statistical Methods in Steel Industry" by A. V. Sukhatme. *Transactions of the Indian Institute of Metals* v. 7, 1953, p. 123-136.

The application of statistical quality techniques at the Tata Iron & Steel Co., Jamshedpur, India is discussed. The application of control charts to several operations is indicated along with sampling and specialized techniques such as correlation analysis.

APPLICATION—TEXTILE INDUSTRY

IMPROVED SIMPLIFIED ANALYSIS CHART, by Norbert L. Enrick
(Modern Textiles—v. 36, n. 10, Oct. 1955, p. 60)

Revised chart for old chart in Fig. 23, Jan. 1954, issue of *Modern Textiles*. Shows condition found and indicated action in terms of values of certain coefficients of within-machine and overall variations.

HOW TO USE STATISTICAL CONTROL FOR HOSIERY LENGTHS, by A. Glaskin, Hosiery & Allied Trades Research Assn., Nottingham, England)
(Textile World—v. 105, n. 9, Sept. 1955, p. 118-119)

Three basic problems and their statistical control are presented. These are:

a. Control of length variation by frequency diagrams (Histograms)
b. Correlation between gray and finished hosiery lengths by scatter diagrams.
c. Individual control chart to indicate selvage heads out of line on length.

APPLICATION—MISCELLANEOUS

HOW TO PUT PACKAGE FILL UNDER CONTROL, by Frank H. Lawler
(Food Engineering—v. 27, n. 9, Sept. 1955, p. 62-64)

The problem of package fill control was discussed at an American Management Association clinic in New York. In addition to other problems related to fill, the use of SQC at the following companies was discussed: The Nestle Co., G. Washington Coffee, Burnett Div., C. F. Mueller Co., The Borden Co., General Mills, Inc., and Thomas J. Lipton, Inc.

Selected references in the Bibliography of *Industrial Quality Control* are obtained from the following sources:

The International Statistical Institute, *International Journal of Abstracts on Statistical Methods in Industry*.

Equipment used and advantages of control were also noted.

THE STATISTICAL NATURE OF FRICTION, by E. Rabinowicz, B. G. Rightmire, C. E. Tedholm and R. E. Williams

(Transactions of the American Society of Mechanical Engineers—v. 77, n. 7, Oct. 1955, p. 981-984)

This article describes a series of experiments investigating the nature of friction and the details of statistical analysis of this result. The frequency distribution of test data is analyzed by comparing the actual with a theoretical normal of the Chi-Square Test. Standard deviation of test results is used as a measurement of comparison of various surface and operating conditions.

QUALITY CONTROL FOR CUSTOM MOLDERS, by John B. Whitted, Jr. (Whitso, Inc. and Marion Molding Corp.)

(Modern Plastics—v. 33, Nov. 1955, p. 117-120)

This article describes a quality control set up for a custom molder of thermosetting plastic. Starting with the review of the customer's drawings to determine if the specifications required are compatible with the "natural tolerances of the process," the author discusses control of such variables as shrinkage in the mold first between samples and in process control. A formula is developed which will give the number of samples required for a predetermined risk of error in arriving at shrinkage figures for a given dimension. A study of pre-run samples to determine process variability for a given mold design is also considered. The submission of samples from the completed mold and the controlling of the process during operation by a modified $\bar{X}$ and R technique is used. Sample plans for final acceptance based on Mil-Standard 105A are recommended.

STUDY OF VARIATION OF BASIS WEIGHT AND CALIPER, by M. S. Renner

Tappi—v. 38, n. 7, July 1955, p. 430-2)

This study is based upon a process capability analysis procedure developed by Seder and Cowan. Through this approach, variation of data from paper mill run sheets is obtained and expressed in simple numbers. These can then form the basis of additional studies that may be desired.

ENGINEERING AND EXPERIMENTS

A MONOGRAPH FOR DETERMINING SIGNIFICANT DIFFERENCES, by C. H. Li (Radio Corporation of America, Tube Division)

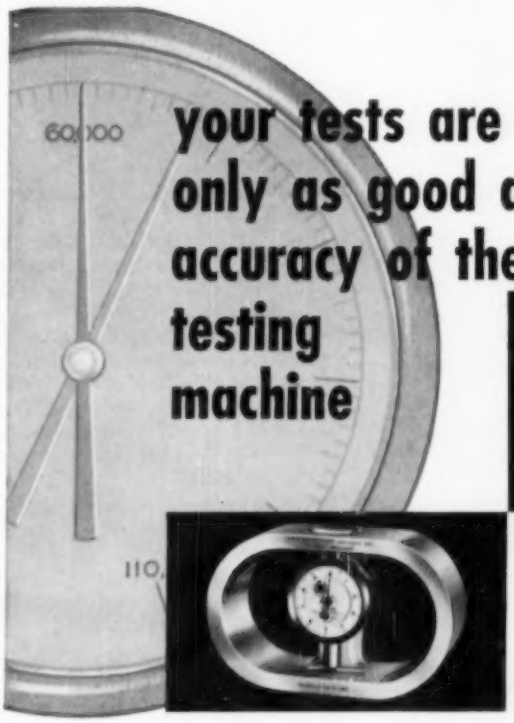
(Metal Progress—v. 68, n. 5, Nov. 1955, p. 104-B and 105)

A simple method for evaluating differences in attribute inspection results. Covers a range of sample sizes from eight to 100,000 and a variety of degrees of significance, a full page nomograph plus one page of explanations and examples.

STATISTICAL DESIGN, by W. J. Youden

(Industrial & Engineering Chemistry—v. 47, n. 8, Aug. 1955, p. 103A-5A)

The order in which observations are made is an important factor in experimental situations. This is illustrated by a discussion of a gun problem where repeated firing of a large gun show continuous decrease in velocity. Various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powders must also be considered. A random procedure is considered with both advantages and limitations noted. Another approach to eliminate the experimental errors due to gun wear is suggested. This is the first in a series.

STATISTICAL DESIGN, by W. J. Youden
(Industrial & Engineering Chemistry—v. 47, n. 10, Oct. 1955, p. 99A, 100A)

This article continues the discussion started in the Aug. 1955 *Industrial & Engineering Chemistry*. Starting with the original problem of several lots of ammunition and a rate of gun wear that was appreciable, the effects of various statistical designs is discussed in more detail. Those considered are systematic firing order versus a random arrangement (this was also discussed in the first article;) and restricted randomization. In this arrangement, the different ammunitions are randomized within one cycle of the period of firing and each of several successive periods have a randomized arrangement of all the ammunition.

MANAGEMENT & PERSONNEL, GENERAL

MANAGERIAL CONTROL, by J. V. McKenna (Syracuse University)
(Mechanical Engineer—v. 77, n. 8, Aug. 1955, p. 662-4)

The overall problem of designing industrial control systems for specific purposes is presented. A chart showing the relation of staff organization and function (quality control and inspection) to line organization and function is given. The relationships are shown for control for complex problems, simpler problems, and on-the-spot control.

THEORY & APPLICATION, GENERAL

THE USE OF STATISTICS FOR ANALYSIS OF TESTING RESULTS, by Charles A. Bicking
(Tappi—v. 38, n. 9, Sept. 1955, p. 573-6)

The measurement of precision of test methods, particularly in the pulp and paper industry is a relatively difficult statistical task. The material itself is highly variable making it difficult to separate the variability of the test from that of the material. Approaches to the problem are discussed. The planning (statistically) of the testing program offers advantages. Various other specific approaches are referred to including the use of process data.

OPERATIONS RESEARCH

FROM PLATO TO THE LINEAR PROGRAM
by Earl of Halsbury.....p. 239

STOCHASTIC PROPERTIES OF WAITING LINES
by Philip M. Morse.....p. 255

AN ANALYSIS OF A RAILROAD CLASSIFICATION YARD
by Roger R. Crane, Frank P. Brown, and Robert O. Blanchard .....p. 262

APPLICATION OF DISCRETE VARIABLE SERVO THEORY TO INVENTORY CONTROL
by Herbert J. Vassian....p. 272

ROAD SAFETY AND TRAFFIC RESEARCH IN GREAT BRITAIN
by W. H. Glanville.....p. 283

PRODUCTION SCHEDULING FOR AN ARBITRARY NUMBER OF PERIODS GIVEN THE SALES FORECAST IN THE FORM OF A PROBABILITY DISTRIBUTION
by Gunnar Dannerstedt..p. 300

PRODUCTION AND INVENTORY CONTROL IN A CHEMICAL PROCESS
by Russell L. Ackoff.....p. 319
(Journal of the Operations Research Society of America—v. 3, n. 3, Aug. 1955)

What's New?

ROY A. WYLIE, *Editor*

When inquiring about "What's New?" items, please mention INDUSTRIAL QUALITY CONTROL.

Manufacturers Engineering & Equipment Corp., Hatboro, Pa., have announced the Model III Photoelectric Analyzer, a new instrument for automatically analyzing, recording and controlling chemical processes involving liquids, vapors, or gases. Accurate automatic recording over many days, without auxiliary attendance, is possible with the Model III Photoelectric Analyzer because of its self-monitoring properties whereby it not only records or controls a process but periodically and automatically checks and re-sets itself to compensate for any smudge accumulation on cell windows or other similar sources of error. The analyzer serves not only as a tool for process control or as an automatic recording analyzer in chemical plants, but equally well in problems involving monitoring and prevention of stream pollution. The instrument will automatically record quantities of gas or vapor in air, down to a few parts per billion, of such substances as mercury, ozone, napthalene, benzaldehyde, nitrobenzene, bromine, sulfur dioxide, xylene and many others. The instrument can be set to give an automatic warning of the presence of noxious vapors in the air or as a system leak detector. It is similar to the instrument described by L. G. Glasser of E. I. du Pont de Nemours Company, Inc., in the July 1955 issue of the *Journal of the Optical Society of America*.

DO YOU HAVE A QUALITY CONTROL PRESENTATION PROBLEM?

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. . . To demonstrate control chart plotting and shift of distribution pattern.

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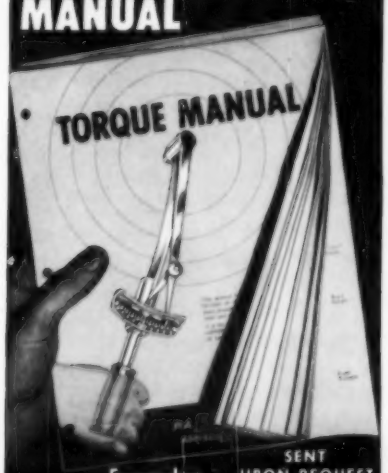
"TORQUE WRENCH" MANUAL



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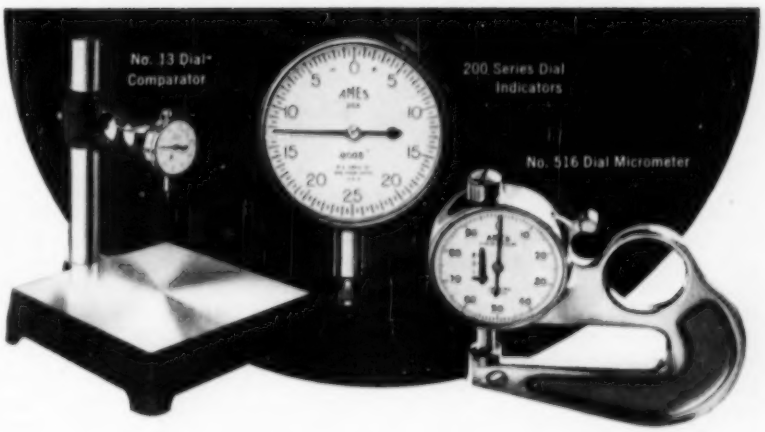

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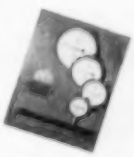

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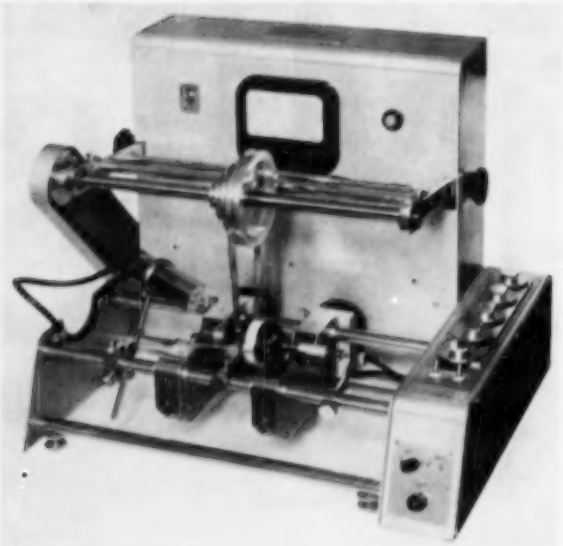

The Hickok Electrical Instrument Co., 10632 Dupont Ave., Cleveland 8, Ohio, announce a new high precision electronic balancing machine which enables smaller cylindrical bodies (such as rotors, armatures, fan units, etc.) to be dynamically balanced. The machine measures unbalance in two planes of correction and locates the unbalance angularly by means of a stroboscopic lamp. Identified as Type 1250, this machine measures out-of-balance masses as low as 0.0013 percent of total weight, which is now the generally accepted standard for high rotational balance. Location and correction determination is usually made within 30 seconds. The part or assembly to be balanced is supported on two cradles and rotated by the machine up to 2,700 RPM. Vibrations due to unbalance masses are picked up by rods in the cradle to generate an alternating voltage proportional to the amplitude of the vibration of the work. This current, amplified and fed to a meter, gives a reliable reading of minute vibrations. The vibrations also actuate the stroboscopic lamp which locates the unbalance angularly. A filter network is included in the apparatus which is set to pass only those vibrations of the work which occur once per revolution. Control switches select either right or left hand plane for correction and readings of each plane are completely independent of the amount of unbalance in the other. Capacity is 13 inches long, 5 inches wide and 10 lbs.

★ ★ ★

New refinements in electronic components and techniques of moisture measurement of paper materials have been announced by **Moisture Register Co.** of Alhambra, Calif. These advances permit sensitive moisture indication in a variety of substances heretofore not measurable by the quick electronic means. Among these materials are cellophanes and many of the newer sheet plastics, polyethylene bags, hard board, new types of asbestos-cement siding and roofing insulating materials, gypsum board, sheet rock, multi-wall bags of various types, and other materials in which moisture is an important factor. The Moisture Register instruments are light in weight, completely portable, and may be used on a production line if need arises. The instruments are particularly useful in quality control operations and do not mar the sample. Each test, which indicates percentage of moisture content, takes only three seconds, and may be made by non-technical personnel. To insure accuracy within close tolerances each instrument is specially calibrated at the factory against the user's samples. Model "K2" has spring-loaded button electrodes for measuring irregular or curved surfaces, and an electronic penetration of one inch for testing rolls or stacks of paper or paper board. Model "V2G" has a large electrode for use on individual thicknesses or thin stacks and has a penetration of ⅛ inch. Another model, G5, is designed for testing of granular or powdered materials used in processing.

CORRECTION

On page 36 of the November issue, there appeared a brief description of the Type II Viscometer offered by the Commercial Research Laboratories, Inc. The ranges of the Type II were listed as being 0.5 to 5.0 and 2.0 to 30 centistokes. The correct ranges are 0.5 to 5.0 and 3.0 to 30 centistokes. We hope that this error has not caused anyone any undue inconveniences.

★ ★ ★

Marconi Instruments, 44 New St., New York 4, N. Y., have announced a torque-operated, feed through wattmeter for precise measurement in the range of 3.05 to 3.45 cms (9840 to 8960 Mc). Produced by Wayne-Kerr Labs, it is an absolute standard in that its calibration depends only upon measurements of mass, length and time. Designed to replace cumbersome calorimetric methods, the instrument makes possible rapid production checks on magnetrons, klystrons and radar equipment. Power may be measured over the range of 10 to 200 watts with accuracies of ± 2 percent to ±3 percent dependent on frequency. Measurements can be made down to 0.5 watt with reduced accuracy. Maximum peak power through the instrument is 50 KW but this may be extended by using directional couplers. V.S.W.R. is better than 1.1:1 while the insertion loss is only 0.1 db. Advantages claimed are high accuracy, portability, speed and ease of measurement.

★ ★ ★

New Literature

"Residual Stresses in Cold-Finished Steel Bars and their Effect on Manufactured Parts" is the title of a newly published, 32-page, pocket-size booklet offered by LaSalle Steel Co., Hammond, Ind. The material presented is a condensed version of a paper given at the ASME Diamond Jubilee Semi-annual meeting at Boston in June 1955 by E. S. Nachtman, manager, Product Engineering Laboratory, LaSalle Steel Co. Specific subjects covered include residual stresses in cold drawn bars, turned bars, ground bars, heat treated steel as well as discussions of fatigue, cracking, machinability, tolerances and corrosion.

A new 37-page bulletin entitled "Measurement of Radio Interference in Accordance with Specification MIL-I-6181B" is available from the Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Boulevard, Hollywood 38, Calif. The bulletin describes the application of radio interference—field intensity measuring equipment in accordance with the standard and clarifies certain little-understood portions of the Air Force and Navy Bureau of Aeronautics specifications.

Daigger "Apparatus Digest" No. 3, published by A. Daigger & Company, 159 West Kinzie St., Chicago 10, Ill., is a 16-page liberally illustrated booklet, depicting a variety of laboratory apparatus and equipment including mobile air conditions, liquid coolers, portable refrigeration systems, flexible heating tapes, interval and signal timers, stop watches, laboratory notebooks, pumps, needle valves, stainless steel laboratory vessels, and vacuum control instruments. Copies are free on request.

Technology Instrument Corp., 521 Main St., Acton, Mass., has prepared an eight page brochure describing the outstanding feature of their extended range Type 800A and 800B Vacuum Tube Voltmeters. In addition, they have issued another in their series of periodic Laboratory Reports, No. 16, entitled "Basic Theory of the Type 300A Vacuum Tube Voltmeter" which discusses in detail the design considerations, giving basic circuits and development logic.

AMERICAN SOCIETY NEWS

Meetings of the Operating and Executive Committees were held on Nov. 17 and 18 followed by the mid-year meeting of the Board of Directors on Nov. 19. All three meetings were held at the Hotel Schroeder in Milwaukee in conjunction with the Tenth Mid-West Conference. The Officers and Directors appreciated the hospitality afforded by this successful meeting of quality control people.

A New Headquarters

The principal topic for consideration at the meetings was the consolidation of the Society's several offices into a single headquarters office and the employment of a full-time Administrative Secretary to handle the Society's rapidly expanding operations. The Board of Directors, on the recommendation of the Operating and Executive Committees, unanimously approved Milwaukee as the location for the new headquarters office. The selection of the new Administrative Secretary is still in process. Plans are currently being worked out for obtaining enlarged office space at Milwaukee and for moving the physical equipment from the New York office to the new quarters. It is expected that all operations associated with the move and the employment of the Administrative Secretary will be completed by about July 1, 1956.

The entire problem of procedures and consolidation got its start as a result of two distinct problems. (1) It was rapidly becoming apparent that the Society's needs were expanding faster than the ability of the present staff to take care of them under our present procedures and separate offices. (2) It was becoming equally apparent that the Society's affairs were expanding to the point where it was difficult for the elected officers to devote the increasingly enormous amount of time being required to take care of them.

The solution to problem (2) was fairly obvious; employ an administrative officer whose duties would be such as to relieve the Society officers of as many of the operation details as possible. Problem (1) is more difficult. The matter of rendering proper service to the members and Sections has been an increasingly important problem as the Society continues to grow. As recently as a year ago an effort was made to meet the increasing service demand by enlarging the staff and revising our procedures. Like the numerous previous efforts it too was largely a stop-gap measure. As the procedural problems continued to grow the Officers and Executive Committee realized that the Society could not continue to operate with half measures which within a short time would prove inadequate anyway.

It appeared to the officers that a consolidation of the several offices into one was a major but logical solution. It will certainly give an administrator more direct control over all the business operations of the Society. Equally if not more important, it will permit more efficient utilization of the Society's staff.

The Officers are confident that the consolidation program is a solution which for the first time will put us ahead of the problem instead of lagging it, and that increased efficiency and improved service to the members will result.

Office Procedures

All procedures are currently being studied with the view of modernizing and streamlining them to permit the Society to further improve its services to the membership. A major phase of this study concerns the matter of processing memberships. Various systems are being studied, including the potential improvements in the current one, to determine which we should use. Each system is being studied from the standpoint of processing new members, renewals, address and other changes, membership records and lists to Sections and Divisions, dues billing, mailing IQC, etc.

The study has already revealed that one of the most difficult procedures to administrate from the Society office is the matter of having membership dues collected by the Sections. Hence at the request of the Operating and Executive Committees, the Constitution and By-Laws Committee has drawn up several constitutional amendments, including one which will permit the direct collection of membership dues by the Society office. These amendments will be submitted for the vote of the members along with the ballot for officers this spring. The amendment permitting direct collection of dues is important to the problem of procedures and to the matter of en-

abling the Society office to render better service. Nevertheless, the amendment is so written that the collection of dues directly by the Society office is not mandatory but permissive.

It is hoped that every section avail itself of the opportunity, which will result in vastly improved service, as well as relief from the task now imposed on the local officers. The new system of direct collection will no doubt have its own problems that will need ironing out, but these can be resolved to the satisfaction of all.

The Officers and Executive Directors have been working on these problems for over a year and are pleased to be able to report this progress toward its solution. They welcome the wholehearted cooperation of the Sections in helping to make the new procedures work.

Deputy Secretaries

In an effort to carry on more effectively the work of the Executive Secretary's office during the transition period, and to continue the study of our procedures problem, two Deputy Secretaries have been appointed. S. A. Oliva of the Southern Connecticut Section and L. S. Eichelberger of the Milwaukee Section have been named to these posts.

Fellows

The Society takes great pleasure in congratulating the following members who have been elected to the grade of Fellow by action of the Examining Committee:

Name	Section
Charles R. Kendel	Cleveland
Fred C. Leone	Cleveland
Weldon D. Parker	New Haven
Axel U. Sternloff	West. Mass.
Robert I. Tenney	Chicago

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ELECTRONIC TUBE MANUFACTURER in Finger Lake region, upper New York state, has opening for a quality control engineer. Bachelor degree or equivalent in electrical, chemical, mechanical or industrial engineering. A minimum of 3 years experience in quality control and inspection desired. Forward resumé with salary requirements to employment manager, Westinghouse Electric Corp., P. O. Box 526, Bath, N. Y.

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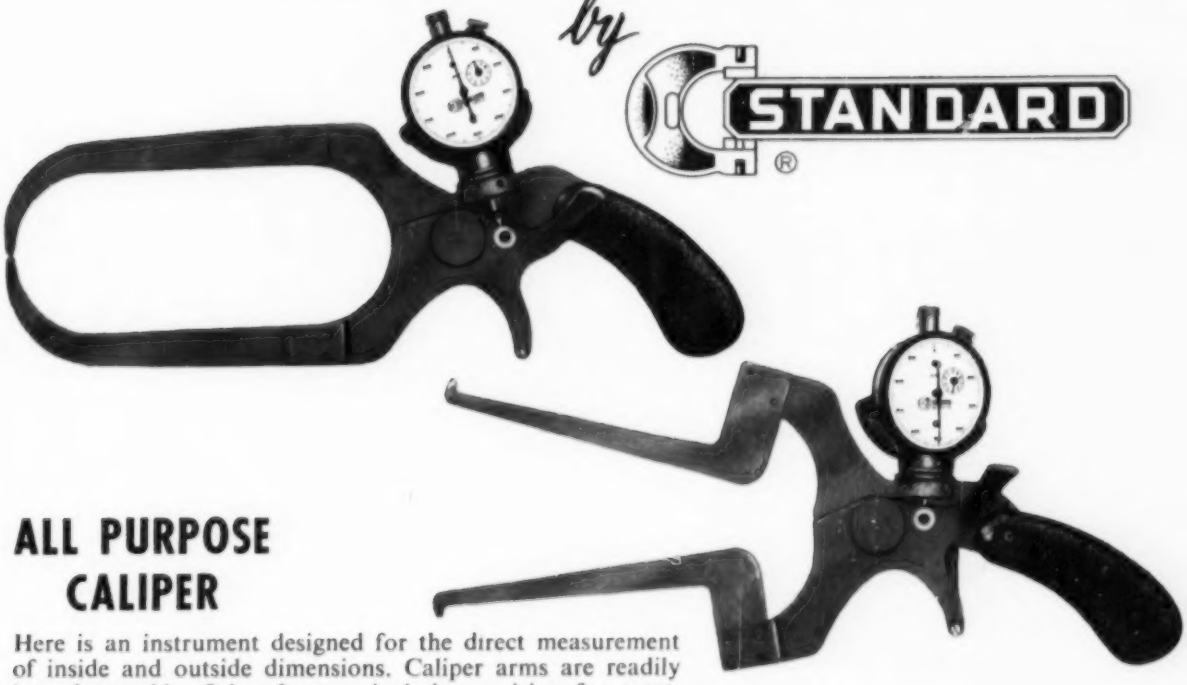
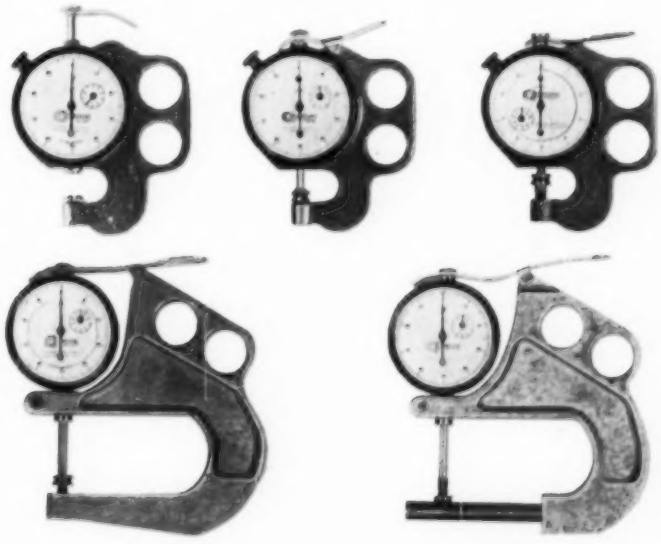
by STANDARD®



ALL PURPOSE CALIPER

Here is an instrument designed for the direct measurement of inside and outside dimensions. Caliper arms are readily interchangeable. Other features include provision for rotating the indicator and a two-position pistol grip. Indicator graduated to .010".



PORTABLE THICKNESS GAGES

Here is a series of convenient, easy-to-use gages designed to check the thickness of sheet metal, plastics, and even compressible materials such as leather. They are also useful for measuring diameters, lengths, and other dimensions of small parts. Deep-throated long range models are useful for clearing obstructions. Model shown at lower right is particularly well suited to measuring the wall thickness of tubing. Model shown at upper right is graduated to .0001"; other models graduated to .001".

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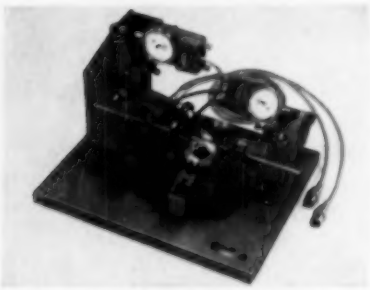
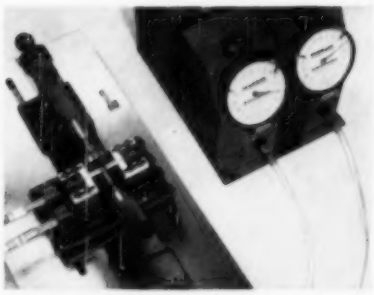


Gage continuously checks width and thickness of square wire travelling seventy feet a minute.

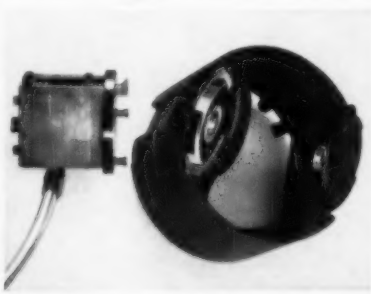
In-Process Gage measures twenty separate dimensions on thirteen different sizes of fabricated stator blades. Discards off-sizes.

Automatic Sorting Gage sorts valve stems for length, diameter, head thickness, hardness, out-of-round, and taper — at 2400 per hour.

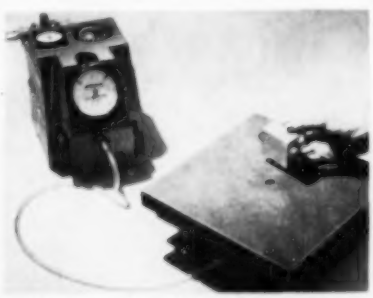
Air Gages



The amount of taper on a small shaft is determined by two 5,000 to 1 Dimensionairs with AirProbes. Measurements are in increments of .000020".

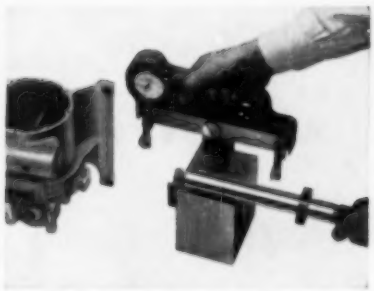


Dimensionair Gage measures a very shallow inside diameter. Frictionless motion-transfer unit contacts AirProbe which takes actual measurement.

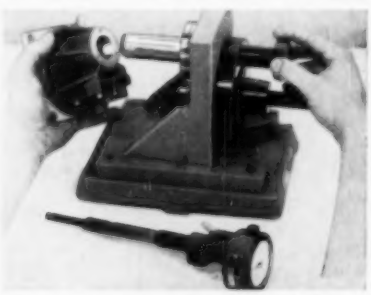


Air-Flatness Gage. AirProbe projects from black granite surface plate. Accurate to .000050" in any 2 x 2 ft. area.

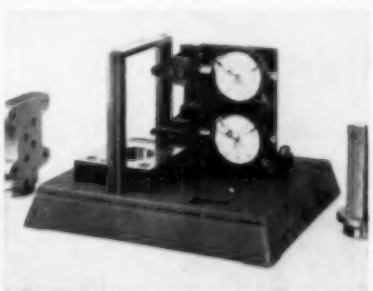
Mechanical Gages



Indicator Gage checks squareness of horizontal bores in relation to vertical bores. Gage shown is being applied to master.



Parallelism of the two lower holes with the large hole, and with each other, is checked on this specially designed fixture.



Dual-purpose Indicating Gage shows (1) squareness of face with flange and (2) distance from centerline to edge of face. Barrier protects contacts.

Whatever your gaging requirements, it pays to check with Federal.

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